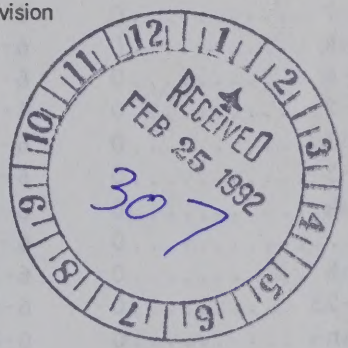
TECHNICAL MANUAL

COMBINED SERVICE, CIRCUIT DIAGRAMS, AND ILLUSTRATED PARTS BREAKDOWN

AMPLIFIER-POWER SUPPLY GROUP OG-90/TSC-60(V)

(208U-3A AMPLIFIER-POWER SUPPLY GROUP)

Collins Telecommunication Products Division
Rockwell International
F19628-68-C-0164
F04606-79-C-0473



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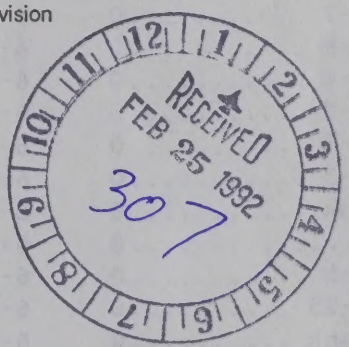

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List of Tables - Titles included in Alphabetical Index

CROSS-REFERENCE INDEX

(Prefix each Reference Number with the Chapter Number denoted by the Column.)

(KEY: Numbers preceded by "f" are illustrations; "s" are illustration sheet numbers; "t" are tables; others are paragraphs.)

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 6 Illustrated Parts Breakdown	Chapter 7 Circuit Diagrams
AMPLIFIER-POWER SUPPLY GROUP OG-90/TSC-60(V)	1 thru 32, f1, t1, t2, t3	1 thru 3, t1	1 thru 6, 12, 114 thru 118, 176, 170 thru 181, t1, f14, f15	1 thru 14, f1	f3, f4
RF Amplifier, Unit 1			6 thru 38, 57 thru 132, t2, t3 f1 thru f2, f4 thru f12	f4, f19	f3
Low-Level Driver Amplifier Assembly 1A1			61 thru 69	f12, f20 thru f23	f3-s1
PA Interstage Network Driver Assembly 1A2			69, 123	f18	f3-s2
Driver Tuning Drive Assembly 1A3			123, 185	f15	f3-s2
Plate Primary Tuning Drive Assembly 1A4			127 thru 128, 187	f27	f3-s2
Secondary Capacitor Tuning Drive Assembly 1A5			129, 189	f26	f3-s2
Loading Coil Tuning Drive Assembly 1A6			130 thru 131, 191	f25	f3-s2
652J-13 Power Supply 1A7			5, 19, 44 t1	f1	
333H-2 Electronic Control Amplifier 1A8			5, 18, 121 t1 f8 thru f11	f1	

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(Prefix each Reference Number with the Chapter Number denoted by the Column.)

(KEY: Numbers preceded by "f" are illustrations; "s" are illustration sheet numbers; "t" are tables; others are paragraphs.)

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 6 Illustrated Parts Breakdown	Chapter 7 Circuit Diagrams
915V-2 Amplifier Control 1A9			5, 17, 96 thru 103, 121 thru 122, 140, 163, t1 f6, f8 thru f11, f13	f1	
309F-1 Digital to Analog Converter 1A10			5, 16, 36, 38 120 t1 f8 thru f11	f1	
915X-1 Control-Monitor 1A11			5, 15 t1	f1	
Interconnecting Panel 1A12				f13	f1 thru f2
Primary Tuning Coil Assembly 1A13			9, 77 thru 80, 127 thru 129	f10	f3-s2
Loading Coil Assembly 1A14			9, 77 thru 80, 130 thru 131	f9	f3-s2
Low-Pass Filter Assembly 1A15			9, 80	f8	f3-s3
Directional Coupler 1A16			10, 81 thru 84	f7	f3-s3
PA Plate Detector Assembly 1A17			103 thru 108, 131 f7, f12	f11	f3-s2
PA Primary Tuning Discriminator 1A18			127 thru 128 f9	f16	f3-s2
PA Secondary Tune Discriminator Assembly 1A19			f10	f14	

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(Prefix each Reference Number with the Chapter Number denoted by the Column.)

(KEY: Numbers preceded by "f" are illustrations; "s" are illustration sheet numbers; "t" are tables; others are paragraphs.)

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 6 Illustrated Parts Breakdown	Chapter 7 Circuit Diagrams
PA Grid Loading Detector Assembly 1A20			130 thru 131 f12	f17	f3-s2
Adjustment Panel 1A21			98 thru 99, 102, 105 thru 106, 108 thru 112, 134, 160, 163 f7, f11 thru f12	f2, f3	f3-s4
Transmit-Receive Relay Assembly 1A22			93	f6	f3-s3
Indicator Light Driver Assembly 1A23			176 thru 181	f24	f3-s4
599Z-1 Electrical Test Panel 1A24			5, 14 t1	f1	
Tune Resistor Switch Assembly 1A25			11, 86 thru 89	f5	f3-s3
Power Supply Unit 2			39 thru 54, 133 thru 169, f3, f13	f28, f30 thru f32, f35	f4
28-V DC Power Supply 2A1			43, 145 thru 148	f38	f4-s2
PA Screen Supply Assembly 2A2			161 thru 163	f33	f4-s3
Contactor-Regulator Sensor Control 2A3			135, 139, 149, 150, 155 thru 157 f13	f29	f4-s1

CROSS-REFERENCE INDEX (Cont)

(Prefix each Reference Number with the Chapter Number denoted by the Column.)

(KEY: Numbers preceded by "f" are illustrations; "s" are illustration sheet numbers; "t" are tables; others are paragraphs.)

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 6 Illustrated Parts Breakdown	Chapter 7 Circuit Diagrams
Low-Level Power Supply 2A4			164 thru 165	f37	f4-s3
Regulator Drive Unit 2A5			135, 141 thru 144, 193 f13	f39	f3-s1
Cooling Air Assembly 2A6			149 thru 153	f36	f3-s2
Bias-Key Chassis Assembly 2A7			54, 94, 166 thru 169	f34	f3-s2

CONFIGURATION STATUS PAGE

Refer to the schematic page preceding each subassembly schematic for any subassembly changes that may have occurred and the corresponding identifier covering each change.

Listed below are the units or subassemblies with the latest applicable configuration identifier and the latest alphabetic identifier covered by this document.

UNIT/SUBASSEMBLY	COLLINS PART NUMBER	LATEST CI EFFECTIVITY	LATEST ALPHABETIC EFFECTIVITY
OG-90/TSC-60(V)	787-6357-001		REV K
Power Amplifier Subassembly	777-5573-001		REV B
Unit 1	777-6450-003		REV V
Subassembly 1A1	777-6489-001		REV P
1A2	777-5982-001		REV J
1A3	777-5983-001		REV P
1A4	777-5984-002		REV M
1A5	777-5984-006		REV M
1A6	777-5984-003		REV M
1A7	792-6337-001		REV B
1A8	777-1602-001		REV D
1A9	777-1568-001		REV D
1A10	777-1570-001		REV D
1A11	777-1571-001		REV B
1A12	777-5546-001		REV E
1A13	777-6495-001		REV C
1A14	777-6496-001		REV D
1A15	777-6497-001		REV B
1A16	777-6498-001		REV H
1A17	777-5997-002		REV H
1A18	777-5998-001		REV D
1A19	777-5999-001		REV B
1A20	777-6000-002		REV F
1A21	777-5987-002		REV K
1A22	777-6499-001		REV G
1A23	777-5985-001		REV F
1A24	787-6657-001		REV D
1A25	777-5710-001		REV F
Unit 2	777-5735-003		REV T
Subassembly 2A1	777-5873-001		REV J
2A2	777-5793-001		REV E
2A3	777-5894-001		REV A
2A4	777-5973-001		REV H
2A5	777-5936-001		REV E
2A6	777-5733-001		REV F
2A7	777-5955-001		REV A
2A8	777-6885-001		REV A

INTRODUCTION

This manual is the official technical manual for the Amplifier-Power Supply Group OG-90/TSC-60(V).

This equipment is used as a linear power amplifier in the AN/TSC-60(V)2 communications system.

This technical manual is made up of the following seven chapters bound in one volume: Chapter 1. General Information; Chapter 2. Installation; Chapter 3. Operation; Chapter 4. Principles of Operation; Chapter 5. Maintenance; Chapter 6. Illustrated Parts Breakdown; Chapter 7. Circuit Diagrams.

Applicable publications governing the use of abbreviations, symbols, reference designations, and terms in this technical manual are as follows:

MILITARY SPECIFICATIONS

MIL-T-9941 (USAF)	Technical Manuals: Ground C-E Equipment, Facility, Site, and System
MIL-M-38730	Manuals, Technical: General Requirements for Preparation of
MIL-M-8910	Manuals, Technical: Illustrated Parts Breakdown, Preparation of
MIL-M-4410E (USAF)	Manuals, Technical: Title Page and List of Effective Pages, Certificate of Destruction Page, Transmittal Notice, Reproduction Assembly Sheet, Photolithographic Negatives, Printing, and Binders.
MIL-M-38784A	Manuals, Technical: General Style and Format Requirements (Used for Title Page Format and List of Effective Pages Only)

MILITARY STANDARDS

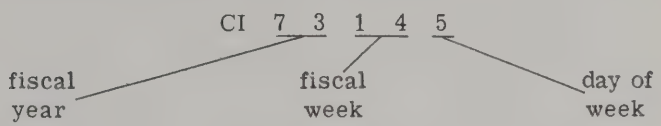
MIL-STD-12B	Abbreviations for Use on Drawings and Technical-Type Publications
MIL-STD-15	Electrical and Electronic Symbols
ASA-STD-Y32.16-1965	Electrical and Electronic Reference Designations
MIL-STD-280	Definition of Terms for Equipment Divisions

TECHNICAL ORDERS

TO 31-1-141	Basic Electronics Technology

CONFIGURATION STATUS CONTROL

There are two methods of identifying the configuration status of the units and subassemblies described in this technical order. One method uses a 5-digit number that is called a configuration identifier (CI). A typical 5-digit CI is constructed as follows:



When a process, electrical, or mechanical change is made on a unit or subassembly, the CI is also changed; for example, if the configuration status of a unit or subassembly is changed on the 5th day of the 14th week of fiscal year 1973, the CI stamped on new units or subassemblies is CI 73145.

When possible, the CI number is marked on the unit or subassembly approximately two spaces following the 10-digit part number. If this is not possible, the CI is located as close to the part number as possible. On circuit cards that have a high density of parts, the part number may be located on one side of the card and the CI on the other side.

NOTE

If two or more CI numbers appear on a unit or subassembly, the CI with the latest date reflects the configuration status.

The second method of identifying the configuration status uses an alphabetic identifier. The alphabetic identifier is preceded by the letters REV (revision) and starts with REV - (dash) if no changes have been processed. The first change is identified as REV A, the second as REV B, continuing through REV AA, REV AB, ..., REV BA, REV BB, and ultimately to REV ZZ, except that the letters I, O, Q, and X are not used individually or combined with another letter.

Some units or subassemblies may have both CI and alphabetic identifiers. In these instances, the alphabetic identifier reflects the latest configuration status.

GLOSSARY

ADC	Analog-to-digital conversion
ALC	Automatic load control
IGC	Internal gain control
DCU	Device control unit
DCFE	Device control functional element
ADL	Anode dissipation limiter

INTRODUCTION (Cont)

WARNING

This device contains a radio frequency amplifier which, when operated into an antenna, may produce electromagnetic fields in close proximity to the antenna that are in excess of the Occupational Safety and Health Administration (OSHA) recommended maximum limits.

TPZ-0987-017

Figure 1-1. Amplifier-Power Supply Group OG-90/TSC-60(V), Overall View

CHAPTER 1
GENERAL INFORMATION

1-1. GENERAL.

1-2. This element presents the purpose, specifications, general description, principles of operation, and associated equipment for Amplifier-Power Supply Group OG-90/TSC-60(V), figure 1-1, (commonly referred to as the 208U-3A Amplifier-Power Supply Group).

1-3. DESCRIPTION AND PURPOSE.

1-4. The 208U-3A Amplifier-Power Supply Group is an automatically tuned linear rf power amplifier that operates from 2.0 to 29.9999 MHz, and provides an output of 2.5 kW peak envelope power (pep) or continuous average power. The unit requires 0.025 W minimum to 0.100 W maximum rf input power to provide the rated output power. The amplifier is capable of receiving 2 W average input power without damage. Any frequency change within the range of the amplifier may be made in less than 10 seconds. The amplifier may be locally or remotely controlled and is intended for fixed or transportable applications. Figure 1-2 shows compartment identification.

1-5. LEADING PARTICULARS.

1-6. Table 1-1 lists the leading particulars for the 208U-3A Amplifier-Power Supply Group.

1-7. CAPABILITIES AND LIMITATIONS.

1-8. Table 1-2 lists the capabilities and limitations for the 208U-3A Amplifier-Power Supply Group.

1-9. EQUIPMENT SUPPLIED.

1-10. Table 1-3 lists the equipment supplied as part of the 208U-3A Amplifier-Power Supply Group.

1-11. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

1-12. ASSOCIATED OPERATING EQUIPMENT. Table 1-4 lists the equipment designed to operate with the 208U-3A Amplifier-Power Supply Group.

1-13. TEST EQUIPMENT. Refer to the associated equipment group manual for a list of the test equipment required to maintain the 208U-3A Amplifier-Power Supply Group.

Table 1-1. Leading Particulars

ITEM	DESCRIPTION
Input power	200 to 250 V, line-to-line, 3- or 4-wire, 3-phase, 47 to 63/380 to 420 Hz. Short duration transients of ±20% accepted without damage.
Dimensions	
Height	70.1 in (178 cm)
Width	29.8 in (75.7 cm)
Depth	29.3 in (74.4 cm)
Weight	920 lb (417 kg).
Cooling	Forced air required. Air system included with no additional parts necessary.

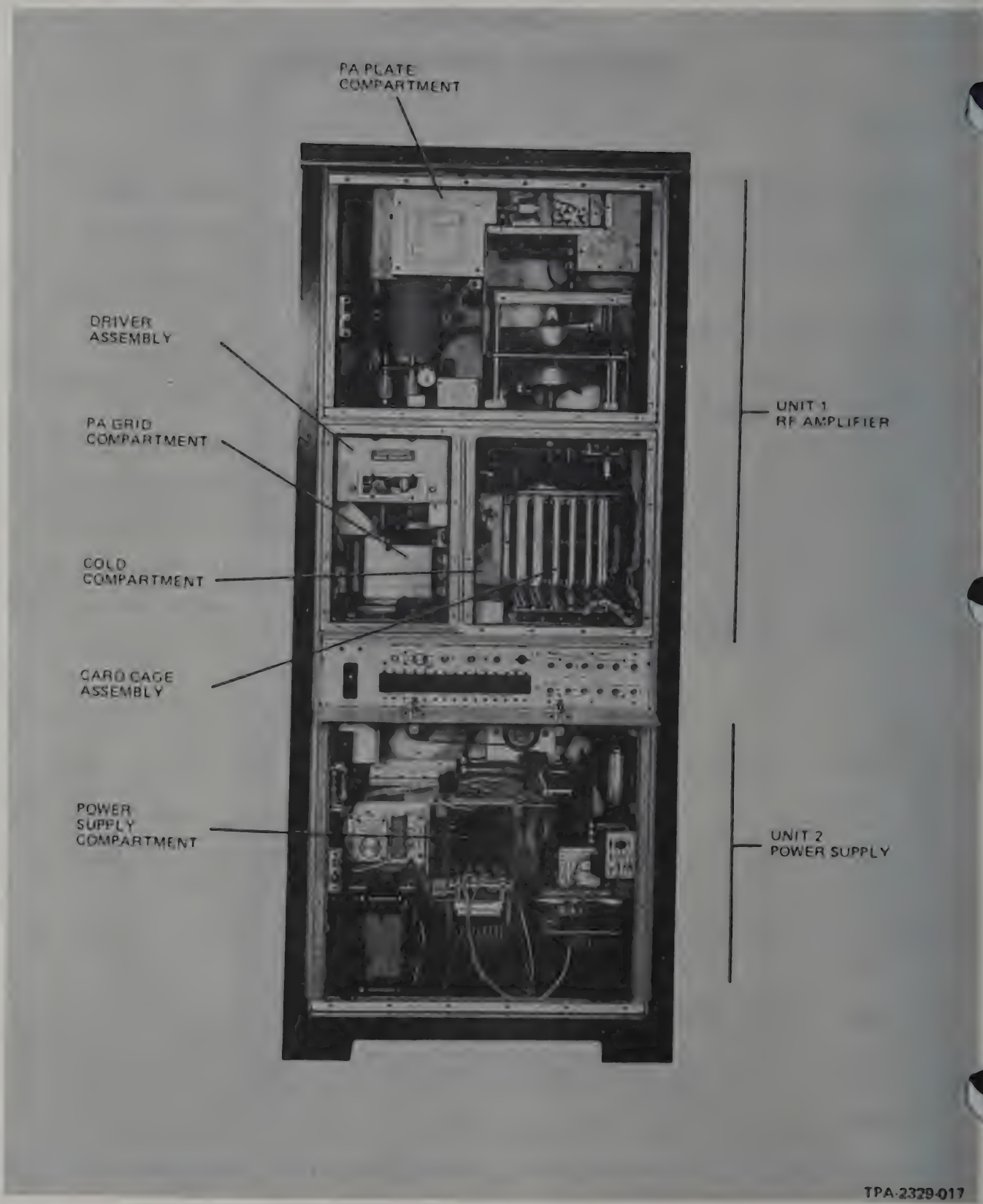


Figure 1-2. Compartment Locations

Table 1-2. Capabilities and Limitations

CHARACTERISTIC	SPECIFICATION
Electrical	
Power input	200 to 250 V, line-to-line, 3-line and ground, 3-phase, 30 A, 47 to 63/380 to 420 Hz. Short duration transients of ±20% accepted without damage.
Typical power consumption	
Condition	WATTS AC / POWER FACTOR
Filament on (standby)	1200 / 0.8
Plate on (unkeyed)	1500 / 0.8
Keyed (static plate currents)	5300 / 0.9
2-tone test at 2.5 kW pep	7200 / 0.9
Single tone CW at 2.5 kW	9100 / 0.9
Rf input	0.025 W minimum to 0.100 W maximum for rated power output. Capable of accepting 2.0 W average power input without damage.
Rf output	2.5 kW pep with two or more equal amplitude tones. 2.5 kW average with one tone continuous duty into a 50-ohm resistive load. 0.6 kW average with noise loading.
Frequency range	2.0 to 29.9999 MHz.
Input impedance	50 ohms unbalanced with a maximum vswr of 1.3:1.
Output load impedance	50 ohms unbalanced with a maximum vswr of 3:1.
Emission	AM, CW, SSB, or any type within the frequency, bandwidth, and power rating limitations.
Rf bandwidth	12 kHz, with less than 0.1 dB variation over a 3-kHz segment centered on the operating frequency.
Intermodulation distortion	
2-tone test	With the intermodulation distortion products of the drive source at least 50 dB below one tone of the 2-tone source, third order and higher order intermodulation distortion products are not less than 40 dB below one tone of the 2-tone test signal at any power level up to rated pep.
Noise-loading test	With the total bandwidth limited to 12 kHz maximum (centered on operating frequency) and the source quiet channel noise at least 50 dB below the average noise power output of the loaded channels, the undesired noise power output is not less than 43 dB below the desired average noise power output at any level up to the rated power output.

Table 1-2. Capabilities and Limitations (Cont)

CHARACTERISTIC	SPECIFICATION
Harmonic output	Second order and higher order harmonic output is not less than 80 dB below the fundamental power output measured on a 50-ohm resistive load at any power level up to rated power output.
Hum and noise	With a 60-dB signal-to-hum and noise ratio drive source, the hum and unweighted noise output in a 12-kHz bandwidth is at least 50 dB below the output level of either of two tones of equal amplitude which drive the amplifier to power levels from 100 W to 2.5 kW pep.
Tuning time	
Tune sequence	6 s nominal, 10 s maximum (after receipt of rf drive).
Loading adjustment	Will readjust for any load change in a 3:1 vswr within 5 s.
Key control time	
Key line grounded	Within 10 ms after the auxiliary key line is grounded, the output power level is within ±1 dB of the power level present during the remainder of the on time.
Key line ungrounded	Within 5 ms after ground is removed from the auxiliary key line, the power output is reduced by at least 50 dB.
Internal gain control (IGC)	During a tune sequence, IGC limits power output to 1.0 kW to protect the amplifier from damage due to overdrive and/or abnormal tuning.
Automatic load control (ALC)	The ALC output operates from a low impedance source to provide a charge time constant of approximately 2 ms to an external load of 25 kΩ shunted by 6.8 μF. The source impedance to reverse polarity shall not be less than 1 MΩ. The ALC output detector delay bias level is switched for high or low power output. ALC output is diplexed on the rf input coaxial line to the exciter and is present only during the operate step of the tune sequence.
High power ALC output	A 1-dB increase in the output level above the point of ALC threshold shall produce not less than -5 Vdc into the specified load impedance when the ALC threshold voltage is adjusted to -1 dB with respect to rated output power. ALC threshold shall not vary more than 1.0 dB.
Low power ALC output	A 1.0-dB increase in the output level above the point of ALC threshold shall produce not less than -3.5 Vdc into the specified load impedance when the ALC threshold voltage is adjusted to -3.5 dB with respect to rated power output. ALC threshold shall not vary more than 1.0 dB.

Table 1-2. Capabilities and Limitations (Cont)

CHARACTERISTIC	SPECIFICATION
Transmitter gain control (TGC)	The TGC output source impedance is not more than 10 kΩ and minimum load impedance for specified performance is 47 kΩ. The source impedance for reverse polarity is not less than 1 MΩ. The TGC output level is switched for high or low power output. The TGC output is diplexed on the rf input coaxial line to the exciter and is present except during the operate step of the tune sequence.
High power TGC output	The TGC output level is adjustable from 0 to -4 Vdc at rated power output. The TGC output level is linear with respect to power amplifier plate voltage swing above a silicon diode gate level.
Low power TGC output	The TGC output level is adjustable from 0 to -4.0 Vdc at 3 dB below rated power output. The TGC output level is linear with respect to power amplifier plate voltage swing above a silicon diode gate level.
Reflected power protection	A reflected power detector unkeys the amplifier when reflected power exceeds 1.0 kW.
Auxiliary key control	A separate key control line is provided for systems that require faster keying speeds than can be provided by serial control. A ground on the auxiliary key line keys the amplifier.
Antenna interlock	The antenna interlock prevents the amplifier from radiating without an rf load. A ground is required through the rf load to enable the amplifier keying circuits. Provisions are available for interlocking followup equipment with the antenna interlock or enabling the keying circuits in systems with no common return through the rf load.
Environmental	
Operating temperature	-40 to +55 °C (-40 to +131 °F).
Storage temperature	-62 to +70 °C (-79.6 to +158 °F).
Humidity range	0 to 95% relative humidity.
Altitude	Pressure equivalent of 12,000 ft (3.656 km).
Vibration	0.030 in (0.0762 cm) double amplitude, 5 to 15 Hz; 0.020 in (0.0505 cm) double amplitude, 16 to 55 Hz, or 1 g constant.
Shock	Three impact shocks of 15 g at 11 ms in opposite directions along each of three mutually perpendicular axes.

Table 1-3. Equipment Supplied

NOMENCLATURE	COMMON NAME	QTY	DESCRIPTION
Amplifier-Power Supply Group OG-90/TSC-60(V)	208U-3A Amplifier-Power Supply Group	1	2.5-kW power amplifier
	Rf amplifier unit 1	1	Rf amplifier
	Low-level driver amplifier assembly 1A1	1	Low-level driver amplifier
	Pa interstage network driver assembly 1A2	1	Interstage network driver
	Driver tuning drive assembly 1A3	1	Driver tuning drive
	Plate primary tuning drive assembly 1A4	1	Plate primary tuning drive
	Secondary capacitor tuning drive assembly 1A5	1	Secondary capacitor tuning drive
	Loading coil tuning drive assembly 1A6	1	Loading coil tuning drive
Power Supply PP-6542/ TSC-60(V)	652J-13 Power Supply 1A7	1	5/12-volt power supply
Electronic Control Amplifier AM-6229/TSC-60(V)	333H-2 Electronic Control Amplifier 1A8	1	Servo amplifier
Amplifier Control C-8366/TSC-60(V)	915V-2 Amplifier Control 1A9	1	Power amplifier control
Digital to Analog Converter CV-2674/TSC-60(V)	309F-1 Digital to Analog Converter 1A10	1	Digital to analog converter
Control-Monitor C-8376/TSC-60(V)	915X-1 Control-Monitor 1A11	1	Control and monitor interface
	Interconnecting panel 1A12	1	Backplane interconnections
	Primary tuning coil assembly 1A13	1	Tuning coil
	Loading coil assembly 1A14	1	Loading coil
	Low-pass filter assembly 1A15	1	Low-pass filter
	Directional coupler 1A16	1	Directional coupler
	Pa plate detector assembly 1A17	1	Plate detector
	Pa primary tuning discriminator 1A18	1	Discriminator
	Pa secondary tune discriminator assembly 1A19	1	Discriminator

Table 1-3. Equipment Supplied (Cont)

NOMENCLATURE	COMMON NAME	QTY	DESCRIPTION
	Pa grid loading detector assembly 1A20	1	Grid detector
	Adjustment panel 1A21	1	Adjustment panel
	Transmit-receive relay assembly 1A22	1	Tr relay
	Indicator light driver assembly 1A23	1	Indicator light driver
Electrical Test Panel SB-3401/TSC-60(V)	599Z-1 Electrical Test Panel 1A24	1	Test panel
	Tune resistor switch assembly 1A25	1	Tuning network switch
	Power supply unit 2	1	Power supply unit
	28-V dc power supply 2A1	1	Power supply
	Pa screen supply assembly 2A2	1	Screen voltage power supply
	Contactor-regulator sensor control 2A3	1	Voltage sensor control
	Low-level power supply 2A4	1	Plate-screen-control voltage power supply
	Regulator drive unit 2A5	1	Regulator control
	Cooling air assembly 2A6	1	Cooling air assembly
	Bias-key chassis assembly 2A7	1	Power supply

Table 1-4. Associated Operating Equipment

NOMENCLATURE	COMMON NAME	PART NO OR MFR MODEL NO	PURPOSE AND DESCRIPTION
Communication Central AN/TSC-60(V)2	Communication central	758-5825-001	2 to 30 MHz, 2.5 kW, hf communication system

CHAPTER 2
INSTALLATION

2-1. GENERAL.

2-2. This chapter provides information for unpacking, inspection, installation, operational checkout, and preparation for reshipment for Amplifier-Power Supply Group OG-90/TSC-60(V) (commonly referred to as the 208U-3A Amplifier-Power Supply Group). The chapter is divided into four sections: Information on installation planning is in section I, installation planning; receiving and unpacking data is in section II, logistics; installation instructions are in section III, installation procedures; and reshipping instructions are in section IV, preparations for reshipment.

SECTION I
INSTALLATION PLANNING

2-3. REFERENCE DATA.

2-4. The following publications supplement the information contained in this section:

a. TO 31-1-8, Implementation of Fixed Communications-Electronics Program

b. TO 31-1-11, Catalog, Standard Facility Equipment Lists

c. AFR 66-5, Installation-Engineering and Installation of Communications Electronic Facilities

d. AFR 86-5 (as amended), Installation Planning and Development, Aircraft Movement and Approach Area Criteria for Permanent USAF Airfields

e. Drawing AW-86-08-05, Ground Controlled Approach System

2-5. SITE SELECTION.

2-6. GENERAL. Refer to TO 31S1-2TSC60-12 for operational site requirements and site selection.

2-7. CONSTRUCTION DATA.

2-8. GENERAL. Refer to TO 31S1-2TSC60-12 for plot plan discussions and power requirements.

SECTION II
LOGISTICS

2-9. RECEIVING DATA.

2-10. The 208U-3A Amplifier-Power Supply Group is shipped in a wooden crate with skid-type runners. Parts, such as the power amplifier tube and vacuum capacitors, may be packaged separately for additional protection. Check the number of packages against the shipping invoice. Refer to table 2-1 for crating information.

2-11. MATERIAL HANDLING.

2-12. No special material handling is necessary for the installation of the 208U-3A Amplifier-Power Supply Group.

2-13. UNPACKING.

2-14. Uncrate the equipment as close as possible to the installation site. This facilitates handling and reduces the possibility of damage. If possible, save all crating and packing material for any necessary reshipment.

2-15. INSPECTION.

2-16. Carefully remove the crating and packing materials and inspect the equipment for physical damage. Check connectors and major components and assemblies that may have been loosened during shipment. Check the contents of each package against the shipping

Table 2-1. Receiving Data

QTY	DESCRIPTION	DIMENSIONS (in)		WEIGHT (lb)	
		CRATED	UNCRATED	CRATED	UNCRATED
1	208U-3A Amplifier-Power Supply Group	32.8 x 31 x 72.5	29.8 x 29.3 x 70.1	1200	920
1	Pa tube	13 x 13 x 20.5	7.5 x 7.5 x 9.25	25	14

invoice or packing list. Report any damage or incomplete shipment to the proper personnel.

2-17. CABLE REQUIREMENTS.

2-18. Cables connecting the rf unit to the power supply unit are supplied and preinstalled. Interconnecting cables between the 208U-3A Amplifier-Power Supply Group and other equipment are supplied with the overall equipment group. Refer to TO 31S1-2TSC60-12 for descriptions of these cables.

SECTION III
INSTALLATION PROCEDURES

2-19. GENERAL.

2-20. Figure 2-1 shows the weight, mounting dimensions, and air duct connections for the 208U-3A Amplifier-Power Supply Group. All cabling enters the equipment from the top.

2-21. POWER AMPLIFIER TUBE INSTALLATION.

2-22. The power amplifier tube is installed as follows:

a. Ensure that the equipment is deenergized and remove the plate compartment door.

WARNING

Voltages as high as 3250 Vdc may be present in the plate compartment if the plate circuits have previously been energized. Use the high-voltage shorting stick to discharge capacitors before reaching into the compartment.

b. Disconnect connector 1P6 from power amplifier plate detector assembly 1A17.

c. Remove the nut that secures the lead from 1A17 to capacitor 1C10.

d. Remove four screws from the corners of 1A17 and remove the assembly.

e. Remove the four screws that secure the tune coil air duct and remove the duct.

f. Remove the screws that secure the lower ends of variable capacitors 1C24 and 1C25.

g. Remove the screw that secures the upper bracket holding capacitor 1C9 and remove the bracket and capacitor.

h. Remove the two screws that secure the front half of the power amplifier tube air chimney and remove the front half of the chimney.

i. Loosen the two screws that secure the power amplifier tube anode clamp and loosen the front half of the clamp.

j. Insert the power amplifier tube in the socket by rotating the tube approximately 60 degrees clockwise while carefully but firmly pushing down.

CAUTION

Avoid damaging the tube socket contact fingers.

NOTES:

1. DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. ESTIMATED WEIGHT: 920 POUNDS.
3. THIS DRAWING IS APPLICABLE TO ALL OG-90/TSC-60(V) TYPE EQUIPMENT BEARING THE COLLINS PART NO. 787-6357-001.

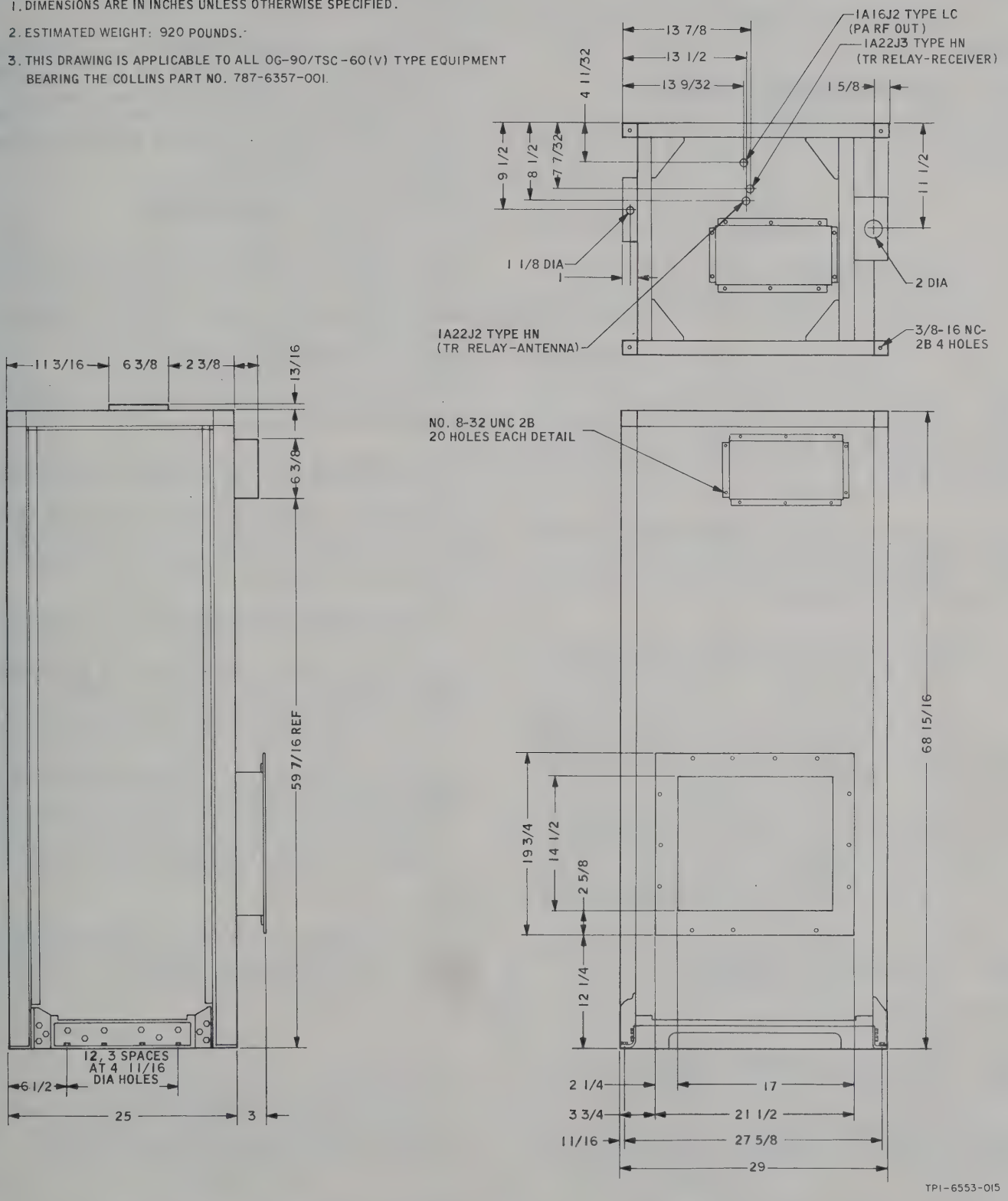


Figure 2-1. Outline and Mounting Dimensions

k. Check the bottom of the tube to be sure that it is properly seated. The bottom of the center cylindrical grid pin should be approximately flush with the bottom of the ceramic socket.

l. Replacement of components is the reverse of removal.

2-23. EXTERNAL SYSTEM CONNECTIONS.

2-24. External connections are made to the unit as follows:

WARNING

All circuit breakers should be off and power must be removed from the primary power input line while making initial connections.

a. Pass the primary power input cable through the hole at the left edge of the top of the equipment. Connect the three power leads to filters 2FL1, 2FL2, and 2FL3, located in the recess in the lower left side of the equipment. Connect the ground wire to the bolt on the left side of the recess.

b. Pass the rf input cable through the hole at the right edge of the top of the equipment. Connect the cable to connector 1J1, located in the middle of the right side of the equipment.

c. Connect the rf output cable to connect 1A16J1, located in the right center of the top of the equipment.

d. Connect the receiver rf input cable to connector 1A22J1, located on the top of the equipment next to the rf output connector

e. Pass the system control cable through the hole at the right edge of the top of the equipment. Connect the cable to connector 1J2, located on the right side of the equipment next to the rf input connector.

f. Secure all cables to the sides of the equipment and to wiring ladders as necessary.

2-25. MECHANICAL CHECKS.

2-26. The following mechanical checks should be made before primary power is applied to the unit:

a. Check cooling system for proper fit and sealing. Check air filter and seals around compartment doors for proper fit.

b. Make sure all connectors fit properly.

c. Check the operation of the interlock switches operated by the compartment doors.

d. Check the operation of high-voltage shorting switches 1S2, 1S4, 2S3, and 2S4. When the doors are open, each switch should measure less than 1 ohm across its terminals. Operate one switch at a time with the remaining switches open.

e. Check that the high-voltage shorting sticks are in their mounting clips in both the power amplifier plate compartment and the power supply unit. Check for secure ground connections. The resistance between the shorting stick conductor and chassis ground should be less than 1 ohm.

2-27. COOLING SYSTEM CHECKS.

2-28. GENERAL. The 208U-3A Amplifier-Power Supply Group is cooled by a blower that operates on either 47- to 63-Hz or 380- to 420-Hz power. The blower needs no adjustment. The dual windings are automatically switched to accommodate the input frequency. Single-step pulleys on the motor and fan provide sufficient fan speed to cool the equipment under any ambient condition within the range of the equipment specifications.

2-29. ADJUSTMENTS AND OPERATIONAL CHECKS.

2-30. After all installation procedures and checks have been performed, check the operation of the 208U-3A Amplifier-Power Supply Subassembly as follows:

a. Turn on shelter and equipment circuit breakers.

b. Turn on transmit control head and maintenance display unit located in the operator's console.

c. Connect the rf output to the dummy load.

d. Set the MONITOR DATA selector switch on the maintenance display unit to PA.

e. Select operating frequency of 16.0 MHz. Enable high voltage, key the equipment, and initiate tune cycle.

f. When operate light comes on, check the MONITOR DATA lamps on the maintenance display unit for the proper indications as shown in table 2-2.

NOTE

The lamps in table 2-2 may flash ON and OFF briefly while equipment is tuning. When tuning is complete, lamps should be as shown in the indication column of the table.

g. If the indications shown in table 2-2 are not obtained on the maintenance display panel, refer to TO 31S1-2TSC60-12 for maintenance and adjustment procedures.

Table 2-2. Fault Monitor Indications

LAMP NO	LAMP MEANING	INDICATION
2	ON indicates power interruption	OFF
3	ON indicates power fault	OFF
4	ON indicates tune fault	OFF
9	ON indicates tune fault (summarized in lamp no 4)	OFF
10	ON indicates reflected power fault (summarized in lamp no 3)	OFF
11	ON indicates pa keyed	ON
12	ON indicates pa plate current fault (summarized in lamp no 3)	OFF
13	ON indicates pa screen current fault (summarized in lamp no 3)	OFF
14	ON indicates rf is not present when unit is keyed	OFF
15	ON indicates access/plug interlock fault (summarized in lamp no 3)	OFF
16	ON indicates circuit breaker fault (summarized in lamp no 3)	OFF
17	ON indicates antenna interlock open	OFF
18	ON indicates regulator fault	OFF

h. Set the MONITOR DATA selector switch on the maintenance display unit to PA ANALOG.

i. Switch the MULTIMETER DISPLAY selector switch on the maintenance display unit through the switch positions shown in table 2-3. Check the MULTIMETER DISPLAY lamp on the maintenance display unit for the indication at each switch position shown in table 2-3.

j. If the indications shown in table 2-3 are not obtained on the MULTIMETER DISPLAY lamp, refer to TO 31S1-2TSC60-12 for maintenance and adjustment procedures.

Table 2-3. MULTIMETER DISPLAY Indications

SWITCH POSITION	MULTIMETER DISPLAY INDICATION
1. INPUT RF V	1.2 nominal
3. DRVR GRID RF V	-2.90 nominal
4. PA GRID RF V (X 100)	-1.60 nominal
5. PA PL RF V (X 1000)	2.20 nominal
6. FWD PWR (X 0.1)	6.50 nominal

Table 2-3. MULTIMETER DISPLAY Indications (Cont)

SWITCH POSITION	MULTIMETER DISPLAY INDICATION
7. REFL PWR (X 0.1)	0.0
8. DRVR TUNE SVO POS	7.90 nominal
9. PRI TUNE SVO POS	6.80 nominal
10. SEC TUNE SVO POS	8.70 nominal
11. LOAD SVO POS	7.50 nominal
12. PA SCR CUR (X 0.01)	4.00 nominal
13. PA PL CUR	1.40 nominal
14. INPUT AMP CATH CUR (X 0.1)	2.50 nominal
15. INPUT AMP SCR VDC (X 100)	2.50 nominal
16. INPUT AMP PL VDC (X 100)	7.90 nominal
17. DRVR CATH CUR (X 0.1)	2.50 nominal
18. DRVR SCR VDC (X 100)	2.50 nominal
19. DRVR PL VDC (X 100)	7.80 nominal
20. PA GRID VDC (X 1000)	-1.00 nominal
21. PA CATH VDC (X 100/1000)	7.90 nominal
22. PA PL VDC (X 1000)	3.10 nominal
23. CONT VDC (X 10)	2.80 nominal
24. REG VDC	5.0 nominal (4.00 to 6.00)

SECTION IV
PREPARATION FOR RESHIPMENT

2-31. GENERAL.

2-32. No special procedures are necessary for crating the 208U-3A Amplifier-Power Supply Group for reshipment. Recrate the various units of the equipment in the original containers, if available. Make certain that all major components and subassemblies are securely fastened. Brace and pad the equipment as originally shipped. Include a dessicant dehydrator in the crate containing the cabinet.

CHAPTER 3
OPERATION

3-1. GENERAL.

3-2. This chapter describes the operating controls and indicators of Amplifier-Power Supply Group OG-90/TSC-60(V) (commonly referred to as the 208U-3A Amplifier-Power Supply Group). Table 3-1 lists and gives the functions of the controls and indicators located on the front of the 208U-3A Amplifier-Power Supply Group.

3-3. OPERATION AND CONTROL. Refer to TO 31S1-2TSC60-12 for the operation and control of the 208U-3A Amplifier-Power Supply Group.

Table 3-1. Controls and Indicators

*CONTROL OR INDICATOR	ITEM	FUNCTIONS
MAIN circuit breaker	2CB1	Protects primary wiring and the voltage regulation transformers 2T5 and 2T6.
CONTROL POWER circuit breaker	2CB2	Protects the +28-Vdc supply transformer 2T4 and rectifier 2A1CR1.
Driver FILAMENT circuit breaker	2CB3	Protects input amplifier filament transformer 1T2 and power amplifier filament transformer 1T1 in the rf unit.
Power amplifier FILAMENT circuit breaker	2CB4	Protects variable transformer 2T5 and transformer 2T6 in the power supply unit and power amplifier filament transformer 1T1 in the rf unit.
LOW LEVEL circuit breaker	2CB5	Protects low-level supply transformer 2T3 and full-wave bridge rectifier 2CR1.
BIAS-KEY circuit breaker	2CB6	Protects bias supply transformer 2A7T1 and full-wave bridge rectifier 2A7A1CR1.
POWER AMPLIFIER PLATE circuit breaker	2CB7	Protects plate supply transformer 2T1 and full-wave bridge rectifier 2CR2.
POWER AMPLIFIER SCREEN circuit breaker	2CB8	Protects screen supply transformer 2T2 and full-wave bridge rectifier 2A2CR1.
PA BIAS ADJUST potentiometer	2R16	Provides the power amplifier grid with -900 Vdc operating bias (-100 Vdc with respect to the pa cathode).
PA FIL ADJUST potentiometer	2R17	Provides compensation for power amplifier tube aging.
DRIVER BIAS ADJUST potentiometer	2R18	Provides the operating bias to the grid of driver amplifier tube 1A1V1 (when unkeyed, -68 Vdc; when keyed, -6.5 to -13 Vdc).

Table 3-1. Controls and Indicators (Cont)

*CONTROL OR INDICATOR	ITEM	FUNCTIONS
LINE VOLTAGE REGULATOR ADJUST potentiometer	2R19	Provides a dc voltage proportional to the true rms output of regulator transformer 2T6. Set to provide 0 Vdc at 225-Vac input. If above or below 225 Vac, corresponding dc output (above or below 0 Vdc) is applied to error amplifier 1A9A6A1.
LINE VOLTAGE REGULATOR DISABLE switch	2S2	Disables regulator drive unit 2A5 by opening the drive voltage path to servo motor 2A5B1.
FILAMENT HOURS elapsed time meter	2M1	Records total operating time of the amplifier tube filaments in the rf unit.
**CONTROL indicator	1DS4	Amber lamp. Indicates +28-Vdc control power is on.
**FILAMENT indicator	1DS1	Green lamp. Indicates low (filament) voltage is on.
**PLATE indicator	1DS2	Red lamp. Indicates high voltage is on.
**READY indicator	1DS3	Blue lamp. Indicates tuning is complete.

*All switches and circuit breakers located on the front of the amplifier must be in the up (ON) position for operation of the amplifier. The potentiometers that are not discussed in this table and that are located on the front of the amplifier are preset and are for maintenance purposes only.

**These indicators are located at the top of the amplifier. All other controls and indicators are located on the adjustment panel assembly.

CHAPTER 4
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This chapter contains the principles of operation for the 208U-3A Amplifier-Power Supply Group. A functional block diagram discussion is in section I, functional system operation; a detailed presentation of individual circuit areas is in section II, functional operation of electronic circuits; and a description of the operation of the various mechanical assemblies is in section III, functional operation of mechanical assemblies.

SECTION I
FUNCTIONAL SYSTEM OPERATION

4-3. GENERAL.

4-4. The 208U-3A Amplifier-Power Supply Group is composed of three systems: the rf system, the control and monitoring system, and the power supply system. The rf system amplifies 0.1-W maximum rf signals from an external exciter to a rated power output of 2.5 kW. The amplifier automatically tunes to any rf input signal in the 2- to 29.9999-MHz range and amplifies any type of rf signal not exceeding the bandwidth of the rf amplifier stages. The control and monitoring system transfers and monitors control information between the power amplifier and the external exciter by means of three bus lines (carrier, control, and monitor bus). The control and monitoring system also includes interface for the multiplexing, power supply, amplifier gain control, servo tuning and band switching, monitoring, and protective device circuits. The power supply system supplies the power required by the rf amplifier system.

4-5. This section describes the operating principles on a functional level. Operating principles of the six plug-in subassemblies are included only to the level necessary to make the overall description meaningful. A more extensive theory of operation is provided in separate manuals for each plug-in subassembly. Table 4-1 lists the publication references for these plug-in subassemblies.

4-6. RF SYSTEM. (Refer to figure 4-1.)

4-7. Input signals are applied from the external exciter to feedback mixer-amplifier 1A1Q1. The feedback mixer-amplifier amplifies the incoming rf signal to the level required by input amplifier 1A1V1. Negative rf feedback from the output of power amplifier 1V1 reduces intermodulation distortion.

4-8. The output of the feedback mixer-amplifier is applied to input amplifier 1A1V1. The input amplifier is a broadband amplifier that provides nearly constant voltage gain for all rf input signals. The input amplifier bias is controlled by internal gain control (IGC) amplifier 1A9A5. The IGC protects the rf amplifier from overdrive, mistuning, or incorrect loading conditions. During normal operation, the output of power amplifier 1V1 is sampled and fed back to the IGC circuits located in Amplifier Control C-8366/TSC-60(V), 1A9, where it is detected and applied to IGC amplifier 1A9A5, providing gain control of the rf amplifier stages. During the tune cycle, the forward power level is sampled by directional coupler 1A16 and applied to the IGC circuits, providing gain control. The output from input amplifier 1A1V1 is transformer coupled to driver stage 1A1V2. Driver stage 1A1V2 boosts the rf signal to the level required to drive power amplifier 1V1. The driver grid and plate phase relationship is compared by phase discriminator 1A1A1 to tune the driver plate.

4-9. Power amplifier 1V1 operates into a double-tuned, magnetically coupled, bandpass output network. The power amplifier grid and plate phase relationship is compared by phase discriminator 1A18 to tune primary tuning capacitor 1C13 and primary tune coil assembly 1A13. Secondary tuning capacitor 1C14 is tuned for 90 degrees voltage difference between coils 1A13L1 and 1A13L2 by phase discriminator 1A19. Loading comparator circuits detect the rf level of the power amplifier grid and plate signals and adjust loading coil 1A14L1 to provide proper gain of 1V1. The combination of the output network and low-pass filter 1A15 automatically tunes the rf signal, attenuates undesired harmonics, and matches the power amplifier output to an external 50-ohm coaxial transmission line.

Table 4-1. Publication References

PLUG-IN SUBASSEMBLY	REFERENCE DESIGNATION	TO REFERENCE
Electronic Control Amplifier AM-6229/TSC-60(V) (333H-2)	1A8	31R2-2TSC60-2
Digital to Analog Converter CV-2674/TSC-60(V) (309F-1)	1A10	31S1-2TSC60-122
Amplifier Control C-8366/TSC-60(V) (915V-2)	1A9	31R2-2TSC60-22
Power Supply PP-6452/TSC-60(V) (652J-13)	1A7	31R2-2TSC60-62
Electrical Test Panel SB-3401/TSC-60(V) (599Z-1)	1A24	31S1-2TSC60-62
Control Monitor C-8376/TSC-60(V) (915X-1)	1A11	31S1-2TSC60-102

4-10. Directional coupler 1A16 provides samples of forward and reflected power for metering and monitoring, a sample of reflected power for the vswr overload protection circuit, and a sample of delayed forward power. The delayed forward power sample controls the IGC for tune power.

4-11. Tune resistor switch assembly 1A25 is automatically controlled by Digital to Analog Converter CV-2674/TSC-60(V) (commonly referred to as the 309F-1 Digital to Analog Converter). The assembly has two functions. First, while the power amplifier is tuning, the assembly limits the vswr at the amplifier to 2:1; then, when the amplifier is tuned and while the antenna coupler continues to tune, the assembly limits the power delivered to the coupler to 250 W. When both the power amplifier and the antenna coupler are tuned, the assembly connects the amplifier directly to the antenna coupler.

4-12. CONTROL AND MONITORING SYSTEM. (Refer to figure 4-2.)

4-13. Direct digital control and monitoring are accomplished by a multiplex control system. Interconnection between the system control unit and the 208U-3A Amplifier-Power Supply Group is provided by the control bus, carrier bus, and monitor bus lines. The only control information not carried by these three lines is the TGC/ALC output to the exciter and the key interlock to the antenna or antenna coupler. These two functions are diplexed on the rf coax input and output lines.

4-14. A control command enters the 208U-3A Amplifier-Power Supply Group on the control bus line in the form of a 4800-Hz biphase-modulated signal. Incoming signals are routed through Electrical Test Panel SB-3401/TSC-60(V), 1A24 (commonly referred to as the 599Z-1 Electrical Test Panel), where phone jacks provide entry to the control lines for maintenance purposes. The 599Z-1 Electrical Test Panel also contains switches that control address strapping. The 4800-Hz biphase-modulated signal is then applied to Control-Monitor C-8376/TSC-60(V) 1A11 (commonly referred to as the 915X-1 Control-Monitor).

4-15. The 915X-1 Control-Monitor provides two primary functions: Control information is received, processed, and provided at the interface connections in the form required by the power amplifier control circuits; monitor information from the power amplifier circuits is compiled, processed, and provided in the form required by the system control unit. The device control unit (DCU) in the 915X-1 Control-Monitor demodulates the incoming signal and provides dc (nonreturn to zero) serial control data to the device control functional element (DCFE), also located in the 915X-1 Control-Monitor. The carrier bus incoming signal is a continuous 4800-Hz sine-wave synchronization signal that is detected in the DCU and used to provide a bit clock reference to the DCFE. Monitor information from the power amplifier circuits is compiled in the DCFE and then fed in serial form to the DCU. The DCU biphase modulates the serial monitor data onto a 4800-Hz carrier and sends it, on command, over the monitor bus line to the system control unit. The address strapping established by the address switches in the 599Z-1 Electrical Test Panel ensures that the 915X-1 Control-Monitor DCU recognizes and accepts only those control commands that are addressed to the 208U-3A Amplifier-Power Supply Group.

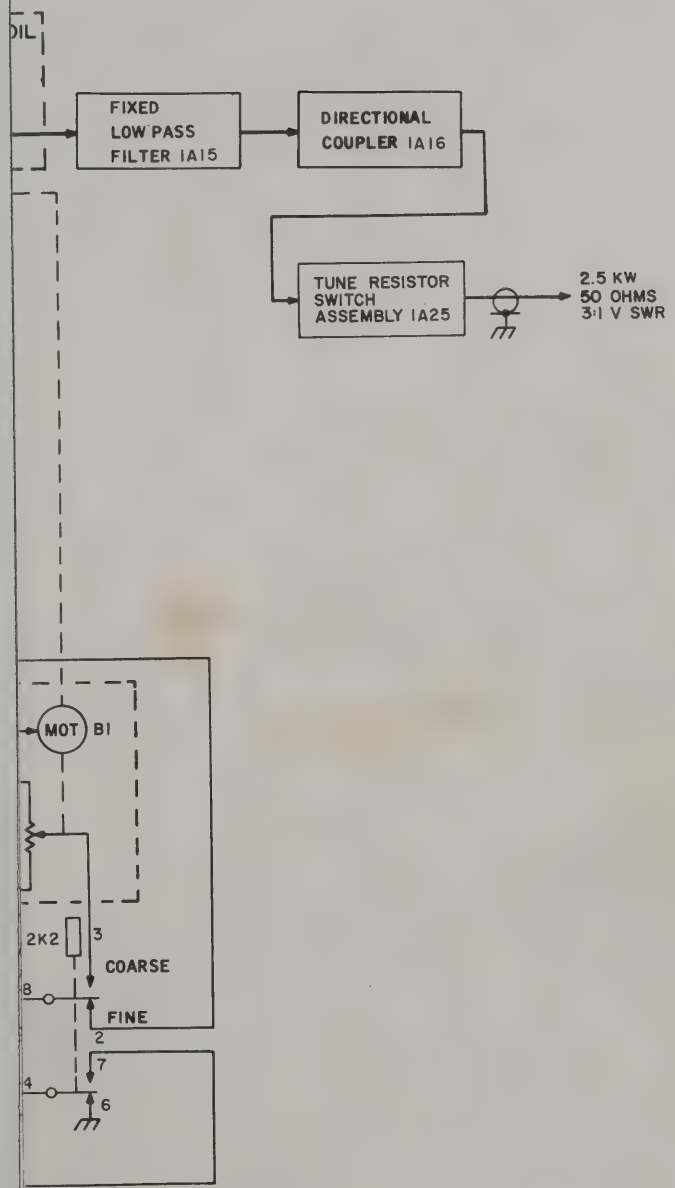


Figure 4-1. RF System, Block Diagram

Table 4-1. Publication References

PLUG-IN SUBASSEMBLY	REFERENCE DESIGNATION	TO REFERENCE
Electronic Control Amplifier AM-6229/TSC-60(V) (333H-2)	1A8	31R2-2TSC60-2
Digital to Analog Converter CV-2674/TSC-60(V) (309F-1)	1A10	31S1-2TSC60-122
Amplifier Control C-8366/TSC-60(V) (915V-2)	1A9	31R2-2TSC60-22
Power Supply PP-6452/TSC-60(V) (652J-13)	1A7	31R2-2TSC60-62
Electrical Test Panel SB-3401/TSC-60(V) (599Z-1)	1A24	31S1-2TSC60-62
Control Monitor C-8376/TSC-60(V) (915X-1)	1A11	31S1-2TSC60-102

4-10. Directional coupler 1A16 provides samples of forward and reflected power for metering and monitoring, a sample of reflected power for the vswr overload protection circuit, and a sample of delayed forward power. The delayed forward power sample controls the IGC for tune power.

4-11. Tune resistor switch assembly 1A25 is automatically controlled by Digital to Analog Converter CV-2674/TSC-60(V) (commonly referred to as the 309F-1 Digital to Analog Converter). The assembly has two functions. First, while the power amplifier is tuning, the assembly limits the vswr at the amplifier to 2:1; then, when the amplifier is tuned and while the antenna coupler continues to tune, the assembly limits the power delivered to the coupler to 250 W. When both the power amplifier and the antenna coupler are tuned, the assembly connects the amplifier directly to the antenna coupler.

4-12. CONTROL AND MONITORING SYSTEM. (Refer to figure 4-2.)

4-13. Direct digital control and monitoring are accomplished by a multiplex control system. Interconnection between the system control unit and the 208U-3A Amplifier-Power Supply Group is provided by the control bus, carrier bus, and monitor bus lines. The only control information not carried by these three lines is the TGC/ALC output to the exciter and the key interlock to the antenna or antenna coupler. These two functions are diplexed on the rf coax input and output lines.

4-14. A control command enters the 208U-3A Amplifier-Power Supply Group on the control bus line in the form of a 4800-Hz biphase-modulated signal. Incoming signals are routed through Electrical Test Panel SB-3401/TSC-60(V), 1A24 (commonly referred to as the 599Z-1 Electrical Test Panel), where phone jacks provide entry to the control lines for maintenance purposes. The 599Z-1 Electrical Test Panel also contains switches that control address strapping. The 4800-Hz biphase-modulated signal is then applied to Control-Monitor C-8376/TSC-60(V) 1A11 (commonly referred to as the 915X-1 Control-Monitor).

4-15. The 915X-1 Control-Monitor provides two primary functions: Control information is received, processed, and provided at the interface connections in the form required by the power amplifier control circuits; monitor information from the power amplifier circuits is compiled, processed, and provided in the form required by the system control unit. The device control unit (DCU) in the 915X-1 Control-Monitor demodulates the incoming signal and provides dc (nonreturn to zero) serial control data to the device control functional element (DCFE), also located in the 915X-1 Control-Monitor. The carrier bus incoming signal is a continuous 4800-Hz sine-wave synchronization signal that is detected in the DCU and used to provide a bit clock reference to the DCFE. Monitor information from the power amplifier circuits is compiled in the DCFE and then fed in serial form to the DCU. The DCU biphase modulates the serial monitor data onto a 4800-Hz carrier and sends it, on command, over the monitor bus line to the system control unit. The address strapping established by the address switches in the 599Z-1 Electrical Test Panel ensures that the 915X-1 Control-Monitor DCU recognizes and accepts only those control commands that are addressed to the 208U-3A Amplifier-Power Supply Group.

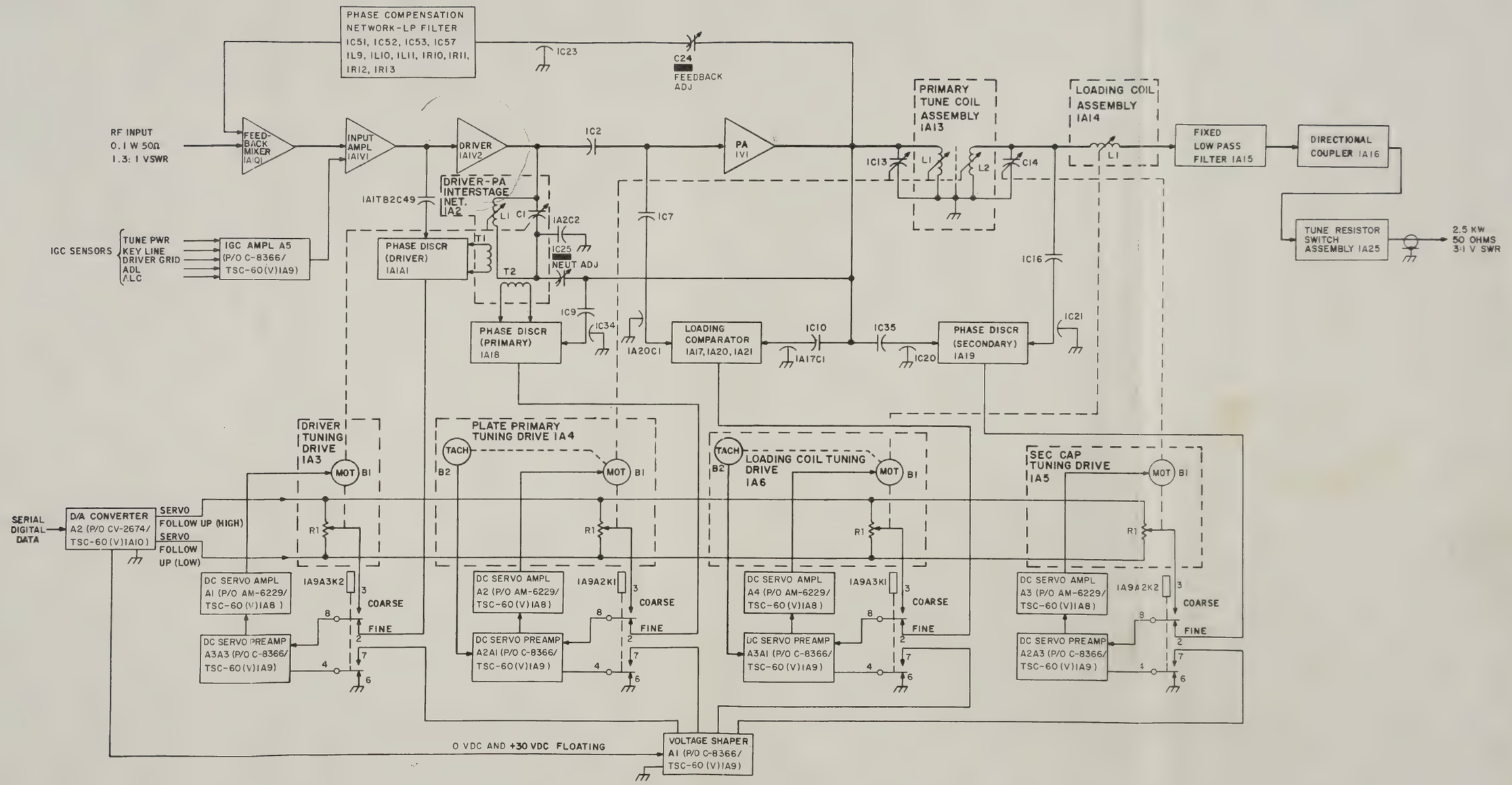


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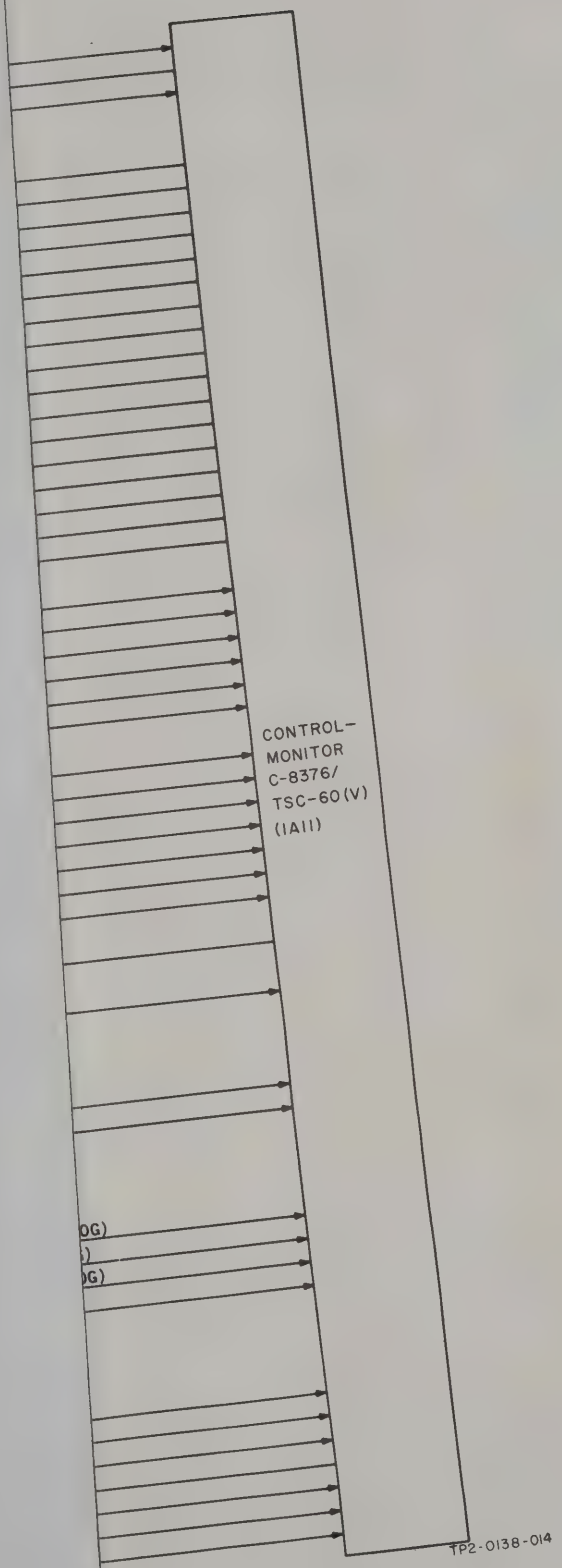
Figure 4-1. RF System, Block Diagram



ntrol System, Block Diagram

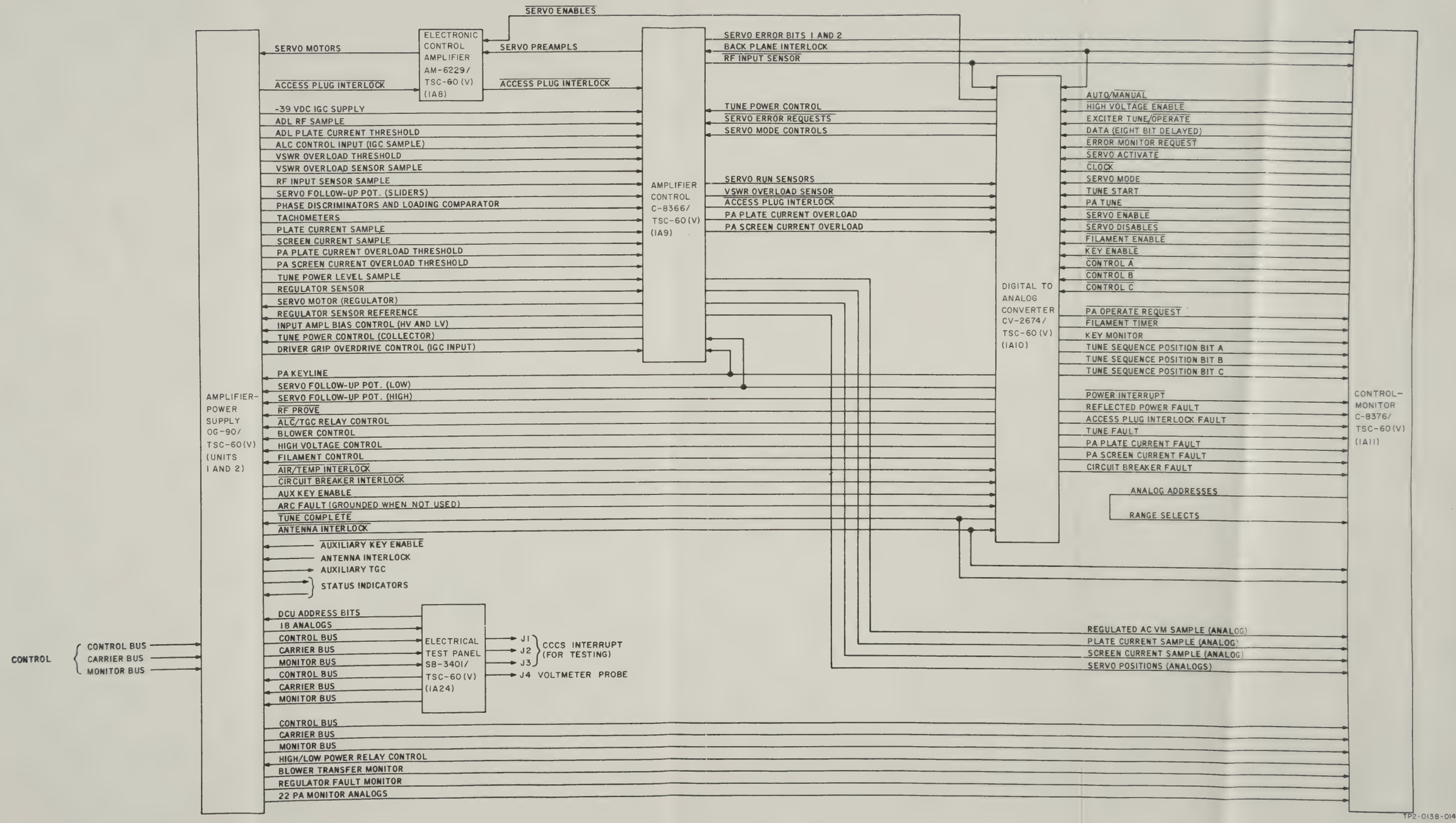


Figure 4-2. Control System, Block Diagram

4-16. Control in[illegible]hen processed by the DCU and DCFE in the 915X[illegible]ntrol-Monitor, are interlocked with monitor inform[illegible]n and sequenced by the 309F-1 Digital to Analog Converter 1A10. The 309F-1 Digital to Analog Converter performs two primary functions: Serial-digital frequency information is converted to an analog signal for coarse tuning the power amplifier and power amplifier operation is sequenced and interlocked with monitor signals for the protection of the equipment. These functions are performed by two functional groups, the digital-to-analog converter group and the control group. The digital-to-analog converter group receives serial-digital frequency data from the DCFE and converts it to an analog voltage proportional to the frequency selected. The control group includes the sequence circuits that control a 7-step tuning procedure of the power amplifier. The control group also contains circuits that provide other control functions as well as interlocks and fault-monitor signals.

4-17. The coarse tuning frequency analog voltage developed by the 309F-1 Digital to Analog Converter is applied to tuning servo-control circuits in Amplifier Control C-8366/TSC-60(V) (commonly referred to as the 915V-2 Amplifier Control). The 915V-2 Amplifier Control contains three functional groups: the tuning servo-control and monitor circuits, the internal gain control circuits, and the primary voltage regulator control circuits. The tuning servo-control and monitor circuits shape the coarse tuning frequency analog and switch coarse or fine tuning voltages to the error amplifiers. (The power amplifier is first coarse tuned and then fine tuned. Fine tuning voltages are provided by discriminators in the rf amplifier circuits.) The error amplifiers compare tuning voltages with voltages from the servo drive unit followup potentiometers and amplify any error output voltages that are developed. The error amplifiers also develop servo-position analog outputs, servo-run sensor outputs, and a servo-error summary output. Internal gain control circuits monitor power amplifier circuits and control the bias level of the input amplifier to protect against overdrive, overload, or improper tuning conditions. Primary voltage regulator control circuits develop an error signal from an rms sensor input. Any error voltage developed is amplified and used to control a dc servo amplifier that drives the regulator drive unit in the power amplifier.

4-18. Tuning error voltages developed by the 915V-2 Amplifier Control are used to control circuits of Electronic Control Amplifier AM-6229/TSC-60(V) 1A8 (commonly referred to as the 333H-2 Electronic Control Amplifier). The 333H-2 Electronic Control Amplifier drives the servo-drive units that tune the power amplifier.

4-19. Power Supply PP-6452/TSC-60(V) 1A7 (commonly referred to as the 652J-13 Power Supply), provides operating voltages for the logic circuits in the power amplifier control components.

4-20. CONTROL AND MONITOR WORDS. (Refer to tables 4-2 and 4-3.) Four control words and two monitor responses are defined. The four control words provide the control information required for 208U-3A Amplifier-Power Supply Group operation. The monitor responses are analyzed to determine the operational status of the system. Each control word is preceded by a 4-bit supervisory period during which the 4800-Hz control bus carrier signal is turned off. This period provides the word synchronizing reference. Each word consists of a dialogic bit, 5 DCU address bits, 2 DCFE subaddress bits, a parity bit, and 23 operand information bits. A dialogic bit 1 identifies a control word and a dialogic bit 0 identifies a monitor word.

4-21. A type I control word is a frequency word that initiates the tune sequence and selects the frequency of operation. A type II control word is a mode word that enables the tuning circuits, controls the power supply voltages, and determines the power level of transmission. A type III control word is a multiplex address word that requests a monitor word 2 and selects the analog voltage to be monitored. A type IV control word is a digital monitor request/maintenance word that requests a monitor word 1 or places the power amplifier under manual control for maintenance purposes. Monitor word 1 is a digital monitor word that is returned to the system control unit after reception of a type I, II, or IV control word. Monitor word 2 is an analog monitor word that is returned to the system control unit after reception of a type III control word.

4-22. TYPE I CONTROL WORD. (Refer to table 4-2.) A type I (frequency) control word is identified by a DCFE subaddress of 00. Reception of this subaddress routes the DCU control gate to the tune cycle circuits as a tune start reset pulse and routes the frequency word to the digital-to-analog converter in the 309F-1 Digital to Analog Converter. The digital-to-analog converter is a digitally controlled ladder resistance network. Incoming serial-digital frequency data controls the ratio of resistance values that are connected across one-half of a resistance bridge circuit. Followup potentiometers complete the bridge. Servo mechanisms coarse tune the power amplifier by driving the followup potentiometers (and power amplifier tuning elements) until the bridge is balanced.

4-23. TYPE II CONTROL WORD. (Refer to table 4-2.) A type II (mode) control word is identified by a DCFE subaddress of 01. This subaddress routes the information to the mode section of the DCFE in 915X-1 Control-Monitor 1A11, where outputs are latched and retained until changed by another control word. The following functions are controlled by type II control words:

Key: Controls the bias level of the driver and power amplifier stages. The key control is paralleled with an auxiliary key control; a key command on either input will key the equipment but both must be disabled to unkey.

Table 4-2. Control Words

BIT NO	TYPE I (FREQUENCY)	TYPE II (MODE)	TYPE III (MULTIPLEX ADDRESS)	TYPE IV (DIGITAL MON REQ/MAINT)
0	Dialogic bit (1)	Dialogic bit (1)	Dialogic bit (1)	Dialogic bit (1)
1	DCU address	DCU address	DCU address	DCU address
2				
3				
4				
5				
6	DCFE subaddress 0	DCFE subaddress 0	DCFE subaddress 1	DCFE subaddress 1
7	DCFE subaddress 0	DCFE subaddress 1	DCFE subaddress 0	DCFE subaddress 1
8	Parity	Parity	Parity	Parity
9	Not used	Not used	Not used	Error monitor request
10	10 MHz 2 (MSB)	Not used	ADC inhibit	Auto/manual tune
11	10 MHz 1 (LSB)	Not used	ADC mux address 16	Servo activate
12	1 MHz 8 (MSB)	Not used	ADC mux address 8	Not used
13	1 MHz 4	Not used	ADC mux address 4	Not used
14	1 MHz 2	Not used	ADC mux address 2	Not used
15	1 MHz 1 (LSB)	Not used	ADC mux address 1	Not used
16	100 kHz 8 (MSB)	Not used	Not used	Not used
17	100 kHz 4	Not used	Not used	Not used
18	100 kHz 2	Not used	Not used	Not used
19	100 kHz 1 (LSB)	Not used	Not used	Not used
20	10 kHz 8 (MSB)	Not used	Not used	Servo 4 disable
21	10 kHz 4	Not used	Not used	Servo 3 disable
22	10 kHz 2	Not used	Not used	Servo 2 disable
23	10 kHz 1 (LSB)	Not used	Not used	Servo 1 disable
24	Not used	Auxiliary function	Not used	Servo 4 mode
25	Not used	Exciter tune	Not used	Servo 3 mode
26	Not used	Medium power	Not used	Servo 2 mode
27	Not used	Low power	Not used	Servo 1 mode
28	Not used	Pa tune	Not used	Control A
29	Not used	Power on/filament on	Not used	Control B
30	Not used	Plate on	Not used	Control C
31	Not used	Key	Not used	Servo enable

Power and filament on: Controls the blower, filament, and bias supply contactors.

Low power: Controls the ALC/TGC transfer relay for low or high power output.

Plate on: Controls the high voltage contactor that energizes the plate and screen supplies.

Pa tune: Set when type I (frequency) word is initiated. Holds pa in tune sequence step 4 (amplifier loading step controlled by tune power) until reset.

Exciter tune: Set by type I (frequency) word. Holds pa in tune sequence step 6 (full power trim) until reset. Used with exciter TGC monitor and pa operate request to provide synchronized TGC/ALC switching to the tune complete sequence step.

Auxiliary function: Not used.

4-24. TYPE III CONTROL WORD. (Refer to table 4-2.) A type III (multiplex address) control word is identified by a DCFE subaddress of 10. Reception of this subaddress activates the analog-to-digital converter and multiplexer in the 915X-1 Control-Monitor 1A11, causing a monitor word 2 (analog) to be returned to the system control unit. Twenty-four analog monitor inputs may be monitored; selection is made by a 5-bit digital address contained in bits 11 through 15. A logic one in bit 10 (analog/digital inhibit) of a type III word will inhibit selection of a new monitor word 2 and will cause the last analog monitor to be repeated.

4-25. TYPE IV CONTROL WORD. (Refer to table 4-2.) A type IV (digital monitor request/maintenance) control word is identified by a DCFE subaddress of 11. If the data bits of this word are all zero, the only result of word reception will be the return of a digital monitor word 1. If a logic 1 is sent in the auto/manual tune bit, servo operation will be determined by the remaining word bits. The following functions are controlled by type IV words:

Auto/manual tune: The automatic mode inhibits all functions in this word except servo enable. The manual mode inhibits the normal tune sequence and enables the manually operated maintenance control functions.

Servo activate control: Manually enables servos if not inhibited by automatic mode, servo-disable function, or tune sequence requirements.

Servo disable: Manually disables servo when not inhibited by automatic mode.

Servo mode: Connects coarse or fine positioning sources to servo systems.

Error monitor request: Monitors servo position. This request, with a servo disable, provides a 2-bit digital monitor indicating plus or negative error or null for the servo disabled.

Controls A, B, C: Provide direct manual control of tune sequence steps.

Servo enable: In tune sequence step 7 the servos are disabled by this control unit when they are nulled (limited to 5 seconds maximum).

4-26. MONITOR WORD 1. (Refer to table 4-3.) A monitor word 1 (digital) is returned to the system control unit after each type I, II, or IV control word. The power amplifier is monitored for possible fault conditions, information is provided for interlocks, and binary readouts are provided for the servo-error indicator and the tune sequence counter. The following information is provided by monitor word 1:

Power interrupt: Indicates if new frequency and mode information is required because of a power interruption involving the control logic circuits.

Power fault summary: Summarizes pa plate current fault, pa screen current fault, access/plug interlock fault, and circuit breaker fault monitors.

Tune fault summary: Summarizes tune fault and reflected power fault monitors.

Pa operate request: Indicates amplifier is ready to advance to step 7, operate.

Pa tune complete: Indicates tuning is complete.

Tune fault: Fault indicates pa has not completed tuning in 20 seconds.

Reflected power fault: Fault indicates vswr has exceeded 3:1.

Key monitor: Indicates if key command has been received.

Table 4-3. Monitor Word

BIT NO	MONITOR WORD 1 (DIGITAL)	MONITOR WORD 2 (ANALOG)
0	Dialogic bit (0)	Dialogic bit (0)
1	DCU address	DCU address
2		
3		
4		
5		
6	DCFE subaddress	DCFE subaddress
7	DCFE subaddress	DCFE subaddress
8	Parity	Parity
9	Power interrupt	Power interrupt
10	Power fault summary	Power fault summary
11	Tune fault summary	Tune fault summary
12	Zero (0)	Filament timer
13	Pa operate request	ADC complete
14	Pa tune complete	ADC sign
15	Zero (0)	ADC overrange (100)
16	Tune fault	ADC output (80)
17	Reflected power fault	ADC output (40)
18	Key monitor	ADC output (20)
19	Pa plate current fault	ADC output (10)
20	Pa screen current fault	ADC output (8)
21	Rf input monitor	ADC output (4)
22	Access/plug interlock fault	ADC output (2)
23	Circuit breaker fault	ADC output (1)
24	Antenna interlock fault	ADC output (0.8)
25	Regulator monitor	ADC output (0.4)
26	Blower transfer monitor	ADC output (0.2)
27	Servo error 2	ADC output (0.1)
28	Servo error 1	Not used
29	Counter out A	Not used
30	Counter out B	Not used
31	Counter out C	Not used

Pa plate current fault: Fault indicates pa plate current limit has been exceeded.

Pa screen current fault: Fault indicates pa screen current limit has been exceeded.

Rf input monitor: Indicates if the rf input level is sufficient for an automatic tune cycle.

Access/plug interlock fault: Fault indicates protective covers, connectors, and subassemblies are not all in place.

Circuit breaker fault: Fault indicates circuit breakers are not all in operating position.

Antenna interlock fault: Fault indicates a dc return is not provided through the rf output coaxial line.

Regulator monitor: Indicates if primary ac input voltage is available and regulated properly.

Blower transfer monitor: Indicates if blower transfer relay is set for 47- to 63-Hz or 380- to 420-Hz input.

Servo error 1 and servo error 2: 2-bit digital readout of a selected servo-system position relative to null.

Counter out A, B, C: 3-bit digital readout of the tune sequence step counter.

4-27. MONITOR WORD 2. (Refer to table 4-3.) A monitor word 2 (analog) is returned to the system control unit when requested by a type III (multiplex address) control word. The type III control word contains a 5-bit address that selects one of 24 possible analog monitor inputs. The analog multiplexer provides switching of the 24 analog monitors from various circuits in the power amplifier to the input of the analog-to-digital converter. The analog-to-digital converter receives the selected input voltage from the multiplexer and converts it to a 3-digit binary coded decimal equivalent which is returned to the system control unit in the analog monitor word. The analog-to-digital converter has a normal range of 10 volts full scale but up to 8 inputs may be strapped for a range of 1 volt full scale. Four digital monitors that indicate the analog-to-digital conversion are returned with the analog monitor. The following information is contained in monitor word 2:

Power interrupt: Refer to paragraph 4-26.

Power fault summary: Refer to paragraph 4-26.

Tune fault summary: Refer to paragraph 4-26.

Filament timer: Indicates filament timer has timed out.

ADC complete: Indicates if analog-to-digital conversion is complete.

ADC sign: Indicates the polarity of the selected analog.

ADC overrange: Indicates if the analog voltage has exceeded the range of the analog-to-digital converter.

ADC output: The following analogs may be selected by a type III control word:

RF VOLTAGES

1. Input
2. Driver grid
3. Pa grid
4. Pa plate

RF POWER

1. Forward power
2. Reflected power

DC VOLTAGES

1. Input amplifier screen
2. Input amplifier plate
3. Driver screen
4. Driver plate
5. Pa grid
6. Pa cathode
7. Pa plate
8. Internal +28-Vdc power

DC CURRENTS

1. Pa screen
2. Pa plate
3. Input amplifier cathode
4. Driver cathode

AC VOLTAGES

1. Regulated primary line

POSITION INDICATORS

1. Driver tuning servo position
2. Primary tuning servo position
3. Secondary tuning servo position
4. Leading servo position

4-28. AUTOMATIC TUNING. Circuit breakers must be on to energize equipment. When a command is received to turn on the power amplifier filaments, the control logic activates the blower (if the access/plug interlock circuit is complete). When the air sensor returns a signal indicating that adequate air is being supplied by the blower, the filaments are enabled and a filament timer is turned on. The timer prevents enabling the high voltage until the filaments have been on for approximately 30 seconds. The filament timer is bidirectional, and, if the filaments have been off for only a short period, the turn-on delay will be correspondingly shortened. The high-voltage enable command may be received at any time. When the filaments have been off, the control logic will cause the power amplifier to go through a tune cycle. After the high voltage has been enabled and the high-voltage monitor indicates that high voltage is present, the control logic will be released to begin a tune cycle.

4-29. The tuning sequence consists of the following seven steps:

Step 1 - Ready to Tune

Tune start is initiated by a new type I (frequency) control word. The sequence counter is set to step 1 and a coarse tuning frequency analog is developed. All four tuning servos are disabled and the equipment remains in step 1 until high voltage is present and all faults and interlocks are satisfied.

Step 2 - Coarse Tune

When the conditions of step 1 have been satisfied coarse tuning may be initiated by a key-enable or an auxiliary key-enable signal. The sequence counter advances to step 2, all four tuning servos are enabled, and the amplifier is coarse tuned. Step 2 is held until the servos have nulled (indicated by the servo-run sensor signals) and rf output from the exciter is present (indicated by the rf input sensor signal). All faults and interlocks must remain satisfied and the transmitter must remain keyed. (Key monitor signal indicates key-enable status.)

Step 3 - Fine Tune 1

Fine tuning is initiated automatically when step 2 conditions are satisfied. The sequence counter advances to step 3, the loading servo is disabled, the servo mode relay switches from coarse to fine tune inputs, and the ALC/TGC relay control selects TGC. The TGC inhibit relay prevents TGC voltage from affecting the exciter output level. The tune power control selects the tuning power output level. Step 3 is held until the servos are nulled and rf is present on the plate of the power amplifier (indicated by the rf prove signal). Fault, interlock, and rf input sensor signals must remain normal and the transmitter must remain keyed.

Step 4 - Fine Tune 2

When step 3 conditions are satisfied, tuning proceeds automatically to step 4. The loading servo is enabled and all four servos are fine tuned. The TGC inhibit relay releases TGC to the exciter. Power amplifier output level is limited to tuning power. Step 4 is held until the pa tune signal indicates the associated antenna coupler has tuned and all four tuning servos have nulled.

Step 5 - Fine Tune 3

The tuning sequence will advance automatically through step 5 to step 6 if servos remain nulled and faults do not exist.

Step 6 - Full Power Trim

When the power amplifier tune signal indicates that associated equipment is tuned, the tune sequence counter advances to step 6 and the tune power control signal enables full power operation of the power amplifier. The power amplifier is still protected against overload by TGC. Step 6 is held until the servos have completed any final trimming necessary and the exciter tune/operate signal indicates that the exciter is tuned.

Step 7 - Operate

When tuning is complete, the tune sequence counter advances to step 7, the servos are disabled, and the ALC/TGC relay control selects ALC. The power amplifier operate request and tune complete signals indicate the power amplifier is tuned and ready to operate.

4-30. The tune sequence must be completed in 20 seconds or less or a tune fault signal will be generated.

4-31. The power amplifier may be trimmed, while in the operate condition, without repeating the tune cycle. A servo-enable command from the system control unit will enable the servos for 5 seconds or until the servos are tuned, whichever is shorter.

4-32. The TGC must be allowed to reset if the output power level of the power amplifier is changed. An exciter tune command from the system control unit returns the power amplifier tuning sequence to step 6, provided that the transmitter is keyed. The TGC will then reset. Completion of the tuning sequence will return the power amplifier to the operate condition.

NOTE

A return to step 6 is inhibited until the amplifier is keyed. This prevents a tune fault signal due to lack of a key signal during the tune sequence.

4-33. All fault signals place the power amplifier in a safe condition, disable the servos, and lock the counter in the step at which the fault occurred. Each fault has a latched output to provide fault identification. Power supply faults may be reset, if the fault has cleared, by cycling the high voltage command. If a fault occurs during a tune cycle, a new tune cycle will be initiated automatically when the fault is cleared.

4-34. Failure of the +5-Vdc supply initiates a power interrupt signal from the 309F-1 Digital to Analog Converter to the 915X-1 Control-Monitor. To prevent errors in the memory circuits, the DCFE in the 915X-1 Control-Monitor places the equipment in a safe condition and requires new information to reset.

4-35. The auxiliary key-enable control line is provided for installations that require faster keying speeds than can be provided with serial control.

4-36. Refer to the principles of operation chapter for the 309F-1 Digital to Analog Converter, TO 31S1-2TSC60-122, for a detailed description of the tune sequence logic control circuits. The 309F-1 Digital to Analog Converter Manual also contains a detailed table of fault and interlock signals and how they affect operation of the 208U-3A Amplifier-Power Supply Group.

4-37. MANUAL TUNING. Manual control of the tune sequence operation may be selected for performance analysis and maintenance. The auto/manual tune bit of a type IV (digital monitor request/maintenance) control word permits direct operator control of the sequence counter, servos, and servo mode. Control A, B, and C inputs select any desired tune sequence step. The servo-activate signal permits manually enabling the servos when they are not inhibited by the tune sequence step selected. Separate servo-disable signals permit individual manual selection of the servos to be disabled. The error monitor request provides a serial-digital servo-position readout for an individually disabled servo.

4-38. Refer to the principles of operation chapter for the 309F-1 Digital to Analog Converter, TO 31S1-2TSC60-122, for a detailed description of the manual tune sequence control logic.

4-39. POWER SUPPLY SYSTEM. (Refer to figure 4-3.)

4-40. The power requirements of rf amplifier, unit 1, are supplied by power supply unit 2, and the 652J-13 Power Supply 1A7. Input voltage (200 to 250 Vac, 3-phase, 47 to 63 Hz or 380 to 420 Hz) enters through MAIN circuit breaker 2CB1 and is regulated by boost transformer 2T6 and variable transformer 2T5. MAIN circuit breaker 2CB1 provides protection for primary wiring and the voltage regulation transformer. The regulated voltage is distributed to the power amplifier tube filament. Contactors (heavy duty relays) provide separate control of plate and screen, blower and bias, and filament supplies. The +28-Vdc supply is not controlled by a contactor.

4-41. When primary power is applied to the 208U-3A Amplifier-Power Supply Group and the circuit breakers are closed, the +28-Vdc supply operates to provide necessary control voltages and blower transfer sensor 2A6A2A1 operates.

4-42. INPUT REGULATION. The rms level of the input voltage is detected by regulator sensor 2A3A1. The regulator sensor output is controlled and amplified by primary power 1A9. Dc servo amplifier 1A9A7 controls regulator drive unit 2A5 that drives variable transformer 2T5. The output of 2T5 is applied to boost transformer 2T6 to regulate the pa filament voltage. Regulation provides a 225-Vac operating voltage for filament transformer 1T1.

4-43. +28-VDC SUPPLY. The +28-Vdc supply provides a +28-Vdc output and a +20-Vdc output. The +28-Vdc output operates control contractors in power supply, unit 2, and servos and relays in rf amplifier, unit 1, 1A7. The +20-Vdc output is regulated by zener diode 1A1CR6 and provides collector bias to feedback mixer-amplifier 1A1Q1. A resistive divider provides a sample output for metering. The +28-Vdc supply is protected by circuit breaker 2CB2.

4-44. 652J-13 POWER SUPPLY. The 652J-13 Power Supply 1A7 operates from 225 Vac from circuit breaker 2CB2 and provides +5-, +12-, -12-, and +20-Vdc control and operating voltages.

4-45. BLOWER. Blower 2A6A1B1 supplies cooling air to the 208U-3A Amplifier-Power Supply Group. When a logic 1 is received on the blower control line, blower contactor driver 2A3A2Q2 energizes blower contactor 2K2 and primary power is applied to blower 2A6A1B1.

4-46. Blower 2A6A1B1 is powered by a 3-phase motor equipped with dual windings to accommodate line frequencies of either 47 to 63 Hz, or 380 to 420 Hz. Blower transfer contactor 2A6A2K1 and blower transfer sensor 2A6A2A1 provide automatic changeover. A monitor signal indicates the position of 2A6A2K1.

4-47. Blower contactor 2K2 also applies primary power to BIAS KEY circuit breaker 2CB6.

4-48. FILAMENT SUPPLIES. When cooling air is available to the 208U-3A Amplifier-Power Supply Group, a logic 1 on the filament control line causes filament contactor driver 2A3A2Q1 to energize filament contactor 2K3. Energizing 2K3 applies 225 Vac

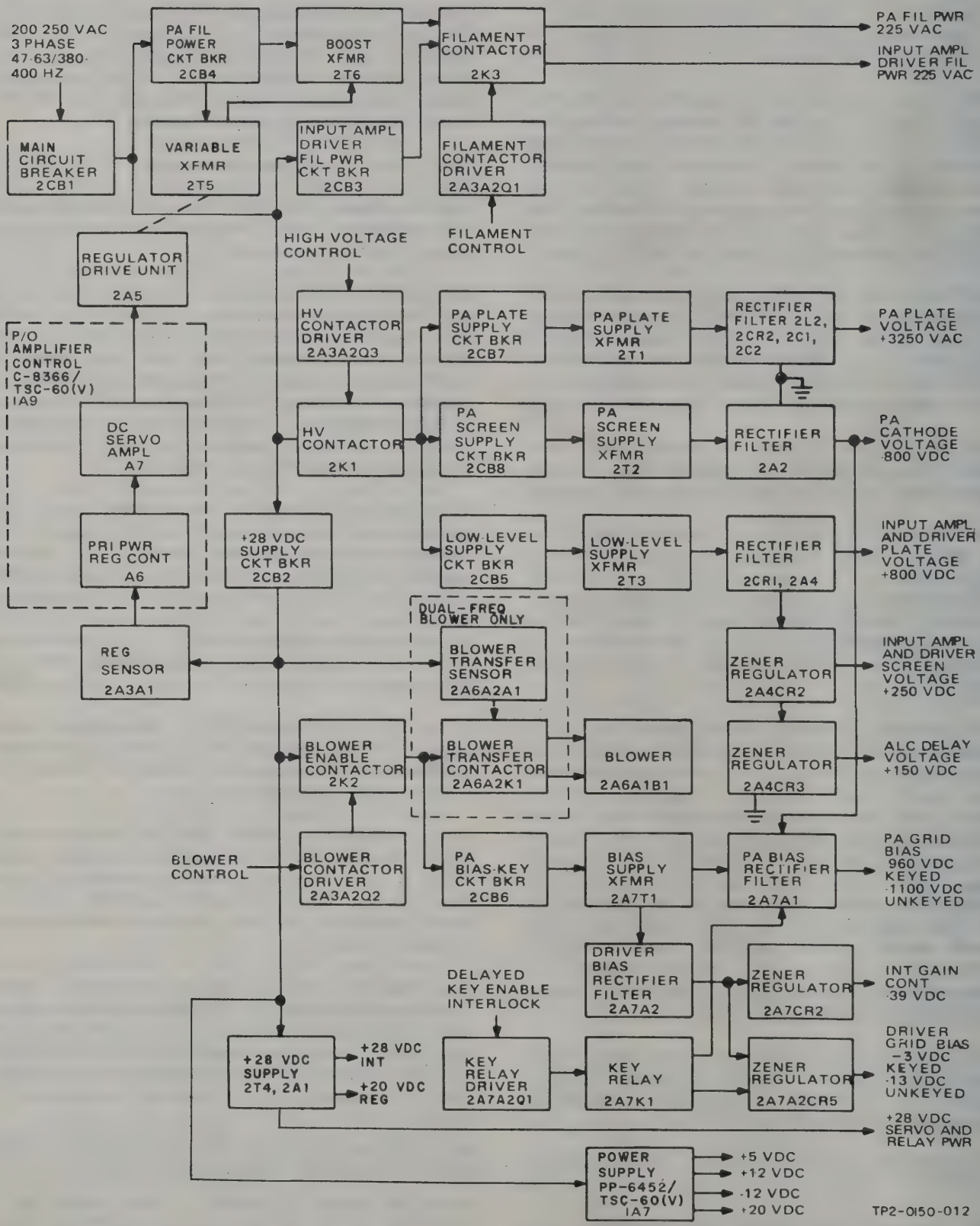


Figure 4-3. Power Supply System, Block Diagram

to power amplifier filament transformer 1T1 and input amplifier/driver filament transformer 1T2. The power amplifier filament supply is protected by FILAMENT circuit breaker 2CB4 and the input amplifier/driver filament supply is protected by FILAMENT circuit breaker 2CB3. FILAMENT HOURS meter 2M1 is also energized by a logic 1 on the filament control line.

4-49. HIGH-VOLTAGE SUPPLIES. When filament power has been available long enough to warm up the tubes, a logic 1 on the high-voltage control line causes high-voltage contactor driver 2A3A2Q3 to energize high-voltage contactor 2K1. Energizing 2K1 applies power to the power amplifier plate, power amplifier screen, and low-level supplies.

4-50. The power amplifier plate supply, consisting of 2CB7, 2T1, 2CR2, 2L2, 2C1, and 2C2, provides +3100 Vdc to the anode of power amplifier tube 1V1.

4-51. The power amplifier screen supply, consisting of 2CB8, 2T2, and 2A2, provides -790 Vdc to the cathode of power amplifier tube 1V1. The -790 Vdc output is also applied to the power amplifier bias supply.

4-52. The low-level supply, consisting of 2CB5, 2T3, 2CR1, and 2A4, provides +790 Vdc to the input amplifier and driver plates. Zener regulator 2A4CR2 provides +250 Vdc to the input amplifier and driver screens. Zener regulator 2A4CR3 provides +150 Vdc ALC delay voltage.

4-53. Each supply is protected by a separate circuit breaker. Overload protection for the power amplifier cathode and screen is provided by current sensors that are monitored by the control logic. Excessive power amplifier cathode or screen current causes an immediate high-voltage shutdown. Metering samples are provided for each output.

4-54. BIAS-KEY SUPPLY. When a blower control command energizes blower contactor 2K2, single-phase power is applied through BIAS KEY circuit breaker 2CB6 to transformer 2A7T1. The two secondary windings of 2A7T1 provide power amplifier, driver, and input amplifier bias power. One winding operates with -790 Vdc from the power amplifier screen supply to provide grid bias to power amplifier tube 1V1. The other winding supplies power for biasing driver and input amplifier grids through filter 2A7A2. The power amplifier and driver bias outputs are controlled by key relay 2A7K1 and driver transistor 2A7A2Q1. The power amplifier bias output is -960 Vdc keyed and -1100 Vdc unkeyed. Driver bias is -3.0 to -13 Vdc keyed and -68 Vdc unkeyed. Zener regulator 2A7CR2 provides -39 Vdc to internal gain control circuits that bias the input amplifier. Zener regulator 2A7A2CR5 provides the keyed driver bias voltage. The unkeyed driver bias voltage is provided by opening the current path of zener regulator 2A-7A2CR5. A sample of the power amplifier grid bias voltage is provided for metering.

SECTION II
FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS

4-55. GENERAL.

4-56. This section contains discussions of the major circuit functions of the 208U-3A Amplifier-Power Supply Group. These functions are divided into five areas: rf amplifier, unit 1; signal control circuits; automatic tuning; power supply, unit 2; and interlocks and indicators. The signal control circuits and automatic tuning circuits are located in the rf amplifier, unit 1, but are discussed separately from unit 1.

4-57. RF AMPLIFIER, UNIT 1.

4-58. A description of the circuit areas of the rf amplifier is found in the following paragraphs.

4-59. Rf amplifier, unit 1, (figure 4-1) located in the upper part of the 208U-3A Amplifier-Power Supply Group cabinet, contains the rf amplification stages, the automatic tuning control circuits and tuning drive assemblies, and the signal control circuits.

4-60. The rf amplification stages consist of transistor feedback mixer-amplifier 1A1Q1, input amplifier 1A1V1, driver amplifier 1A1V2, and power amplifier 1V1. The feedback mixer-amplifier and the input amplifier are untuned wide-band amplifiers that provide relatively constant gain throughout the 2.0- to 29.9999-MHz range. The driver amplifier has a servo-operated, tuned plate circuit and provides sufficient voltage swing to drive the power amplifier. The power amplifier operates into a double-tuned mutually coupled network with an output L-section consisting of tuning capacitors 1C13 and 1C14, primary tune coil assembly 1A13, and loading coil assemblies 1A13 and 1A14. The output network attenuates undesired harmonics and matches the power amplifier output to the transmission line impedance. Output network components are automatically servo tuned for each change of operating frequency. Low-pass filter assembly 1A15 further attenuates rf signals above a nominal 44 MHz. Directional coupler 1A16 samples the forward and reflected power on the transmission line for metering,

gain control, and protection against excessive amounts of reflected power.

4-61. FEEDBACK MIXER-AMPLIFIER 1A1Q1. Feedback mixer-amplifier 1A1Q1 (figure 7-3, sheet 1) is a 2N3375 transistor located on terminal board 1A1TB1 within low-level driver assembly 1A1 in the power amplifier grid compartment. Terminal board 1A1TB1 is in the input amplifier grid circuit section of assembly 1A1 and is shielded from undesired rf signals.

4-62. Feedback mixer amplifier 1A1Q1 is operated class A in a grounded base configuration. Fixed emitter bias from the -12-Vdc power source is supplied through 1A1L7. Regulated +20 Vdc from zener diode 1A1CR6 is supplied to the collector through 1A1L9. Rf feedback from the power amplifier is applied to the emitter through rf feedback connector 1A1J7.

4-63. The rf input from an external exciter is coupled to the emitter circuit of feedback mixer-amplifier 1A1Q1 by transformer 1A1T1. Rf feedback is mixed with the exciter input by diode 1A1CR3 and is applied to the emitter. The output from the collector of 1A1Q1 is coupled to the control grid of input amplifier 1A1V1 through a low-pass filter network. Parasitic suppression is incorporated in the low-pass filter. Effective input impedance of the stage is 50 ohms and effective output impedance is 100 ohms. A detector circuit, consisting of diode 1A1CR1, resistor 1A1R1, and capacitor 1A1C21, provides an rf input sensor sample output that is used for tune sequence control. A similar detector circuit, consisting of 1A1CR2, 1A1R2, and 1A1C30, provides a dc analog of the rf input for metering purposes.

4-64. INPUT AMPLIFIER 1A1V1. Input amplifier 1A1V1 is a 4CX350A radial beam power tetrode. It is located within low-level driver amplifier assembly 1A1 in the power amplifier grid compartment. The plate and grid circuits are separated by an inner wall that shields the input from the output. Air is directed through the fins of the tube to cool it.

4-65. The input amplifier operates as a class A voltage amplifier to provide linear amplification of the input signal. Cathode resistor 1A1R10 provides for current measurements and also develops about 2.5 Vdc bias. The remainder of the operating bias voltage is supplied through 1A1R11 by the internal gain control (IGC) amplifier. The IGC amplifier controls the stage gain by automatically adjusting the grid bias potential. The operating point is set by INPUT AMPL BIAS potentiometer 1A21R8 (figure 7-3, sheet 4). When feedback mixer-amplifier 1A1Q1 (figure 7-3, sheet 1) is driven to saturation, grid current is limited by resistor 1A1R11 in the bias line. The screen grid is maintained at +250 Vdc by a voltage from the power supply applied through resistor 1A1R9. Plate voltage of +790 Vdc is applied through 1A1L12 from the power supply.

4-66. The input amplifier-driver amplifier interstage network consists of 2:1 stepdown transformer 1A1T2 and a filter network that absorbs parasitic capacitances. The filter network consists of capacitors 1A1C54 and 1A1C50, resistor 1A1R17, and reactor 1AL18. The effective output load of the stage is 600 ohms.

4-67. DRIVER AMPLIFIER 1A1V2. Driver amplifier 1A1V2 uses a 4CX350A tetrode identical to the input amplifier tube. It is located within low-level driver amplifier assembly 1A1 in the power amplifier grid compartment. The plate and grid circuits are shielded by an inner wall to isolate the input from the output. The driver grid circuit is in the same compartment as the input amplifier plate circuit. Air is circulated through the anode cooler to remove excess heat.

4-68. The driver amplifier operates as a class A voltage amplifier to provide linear amplification of the input signal. The driver amplifier plate receives +790 Vdc through 1L6 and plate tuning coil 1A2L1. Screen grid voltage at +250 Vdc is supplied through resistor 1A1R14. Bias voltage is applied through 1A1L14. The operating point is controlled by DRIVER BIAS ADJUST potentiometer 2R18 in the power supply. When the amplifier-power supply is keyed, the control grid bias is adjusted from -3.0 to -13 Vdc. When unkeyed, the control grid receives -68 Vdc bias that cuts off the tube. Resistor 1A1R15 in the cathode circuit provides a driver cathode current sample for metering.

4-69. The rf input signal is coupled from the input amplifier plate circuit to the driver amplifier control grid through dc blocking capacitor 1A1C45. The rf output signal is developed across a parallel-tuned plate circuit consisting of 1A2L1 and 1A2C1 (figure 7-3, sheet 2). Effective output impedance is 2000 ohms. The roller coil and variable capacitor are tuned to the operating frequency by grid tuning drive assembly 1A3. Fine tuning is controlled by driver tune discriminator 1A1A1.

4-70. Capacitor 1C1, resistor 1R1, and inductor 1L1 form a swamping network that equalizes variations in driver amplifier gain over the 2- to 29.9999-MHz range of operating frequencies. Parasitic suppression is accomplished by resistor-inductor combination 1A1Z1 in the plate circuit.

4-71. POWER AMPLIFIER 1V1. Power amplifier 1V1 uses a 4CX5000A radial beam power tetrode. The tube is mounted vertically on the power amplifier plate compartment deck so that the plate extends into the power amplifier plate compartment. The control grid and filament extend into the power amplifier grid compartment. The screen grid is flush with the power amplifier plate compartment deck and is grounded to provide internal and external electrical shielding between the input and output circuits. The power amplifier tube is cooled by

forced air from the blower mounted in the power supply compartment. Air is directed through the cooling fins on the power amplifier tube anode and is exhausted upward through the air chimney.

4-72. The power amplifier operates class AB_1, biased at 0.75-A plate current, to reduce distortion while maintaining reasonable plate efficiency. The plate receives +3100 Vdc from the power supply through rf choke coils 1L3 and 1L5. The screen grid is grounded and is maintained positive with respect to the cathode by applying -790 Vdc to the cathode through the center tap of filament transformer 1T1. When unkeyed, -1100 Vdc is applied to the control grid to cut off the tube. When keyed, a nominal -960 Vdc is applied to the control grid from PA GRID BIAS ADJUST potentiometer 2R16 in the power supply.

4-73. The rf signal developed across the driver amplifier plate tuned circuit is coupled to the power amplifier control grid through capacitor 1C2. The rf output signal is coupled to the double-tuned output network through capacitor 1C11 and a filter network. The effective plate load is 1340 ohms.

4-74. NEUTRALIZATION. (Refer to figure 4-4.) Although the grounded power amplifier screen grid minimizes the stray grid-to-plate coupling, neutralization of the power amplifier tube interelectrode capacitances is required because of the power sensitivity of the power amplifier. To neutralize the power amplifier grid-to-plate capacitance, Cgp, the power amplifier plate is coupled through power amplifier neutralization capacitor 1C25 and feedthrough capacitor 1C26 to the driver amplifier plate tuned circuit. The capacitors form two branches of an equivalent bridge circuit. The power amplifier grid-to-plate capacitance, Cgp, and grid-to-ground capacitance, Cgg, complete the bridge circuit. Cgg includes input capacitance, stray tube capacitance to ground, and the output capacitance of the driver amplifier. The input to the bridge, which is developed across the driver amplifier plate tuned circuit, and the output of the bridge, which is developed across the power amplifier tube, are connected across opposite diagonals of the bridge. Neutralization adjustment capacitor 1C25 is adjusted to balance the bridge so that the 1C25-to-1C26 capacitance ratio is equal to the Cgp-to-Cgg capacitance ratio. When the bridge is balanced, no energy transfer occurs between the input and output circuits because the two circuits are electrically neutral with respect to each other.

4-75. RF FEEDBACK. (Refer to figure 4-5.) Inverse rf feedback is applied from the plate of power amplifier 1V1 to the emitter of feedback mixer-amplifier 1A1Q1. The purpose of the multistage rf feedback is to reduce intermodulation distortion.

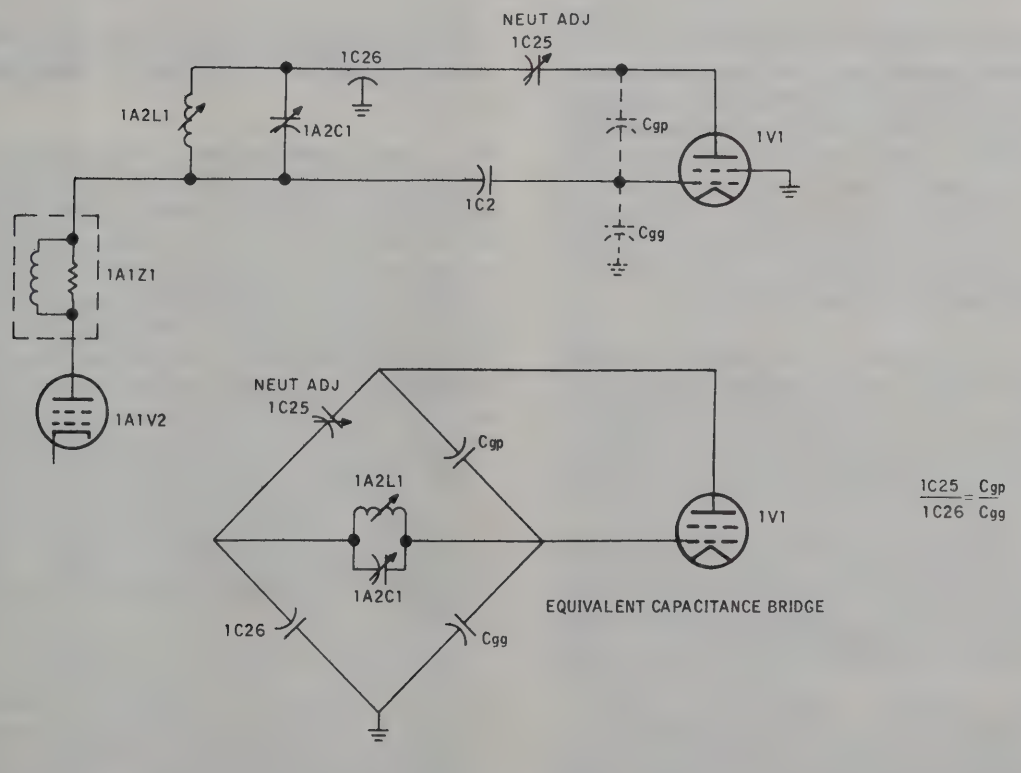


Figure 4-4. PA Neutralization, Simplified Schematic Diagram

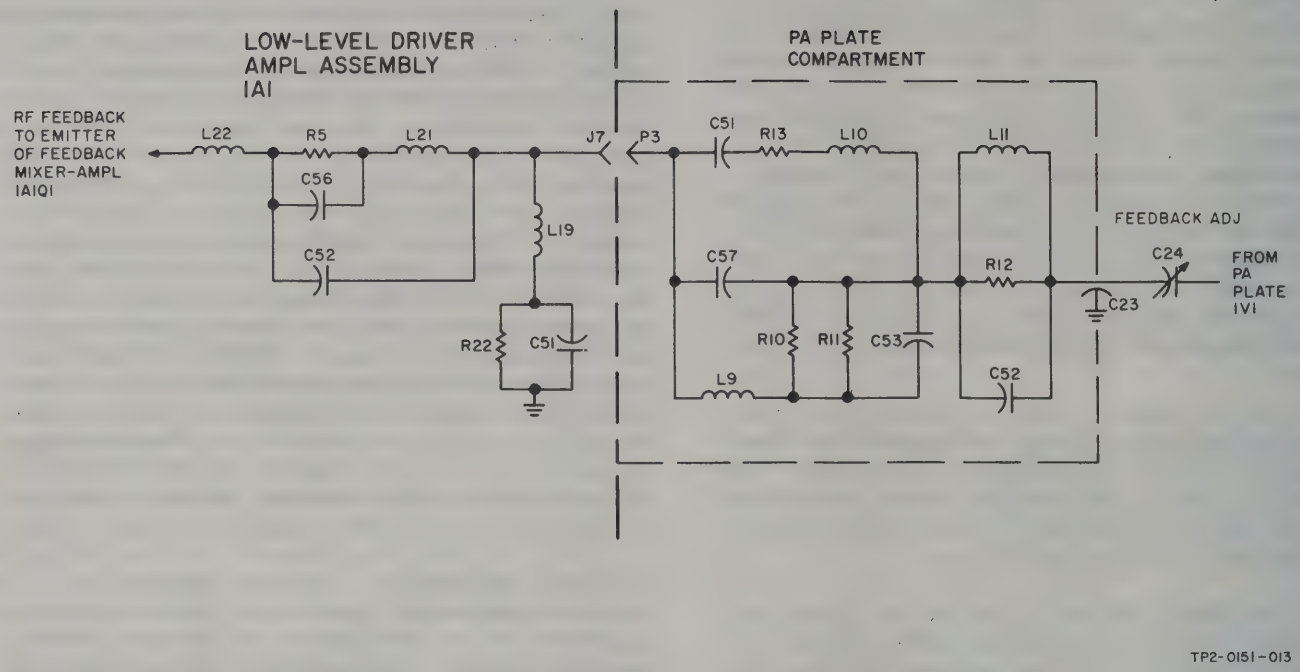


Figure 4-5. RF Feedback, Simplified Schematic Diagram

4-76. The feedback voltage is developed by a capacitive voltage divider consisting of feedback adjustment variable capacitor 1C24 and feedthrough capacitor 1C23. The feedback circuit is a phase compensation network that develops phase lead to cancel phase lag developed in the rf amplification path from 1A1Q1 to 1V1. The rf feedback thus obtained is 180 degrees out of phase with the rf input at the emitter of 1A1Q1. The feedback circuit also acts as a low-pass filter with rising attenuation above about 50 MHz.

4-77. OUTPUT NETWORK. The output network provides an impedance match between the linear power amplifier load and the plate of power amplifier 1V1. The output network also limits the power output of all harmonic frequencies of the operating frequency to at least 80 dB below the fundamental at any power level up to rated power output as measured across a 50-ohm load. The output network is capable of matching a 50-ohm unbalanced load with a maximum swr of 3:1. These properties are valid over the 2.0- to 29.9999-MHz frequency range.

4-78. The output network consists of a primary parallel tuned tank circuit that includes tuning capacitor 1C13 (figure 7-3, sheet 2) and tuning coil 1A13L1, a secondary parallel tuned tank circuit that includes tuning coil 1A13L2 and part of tuning capacitor 1C14, and a tuned L-section that includes part of tuning capacitor 1C14 and loading coil assembly 1A14.

4-79. The output network components are tuned by servo mechanisms. The elements are first coarse positioned and then fine tuned. The primary parallel tuned tank, 1C13 and 1A13L1, and the secondary tuning coil, 1A13L2, are ganged together and tuned for 180 degrees phase difference between grid and plate voltage of power amplifier 1V1. Fine tuning of these elements is controlled by a grid-to-plate phase discriminator. The secondary tuning capacitor, 1C14, is tuned for 90 degrees phase difference between the primary and secondary voltages of the output network. Fine tuning of 1C14 is controlled by a primary-to-secondary coil current phase discriminator. Loading coil 1A14L1 is adjusted for proper gain of the power amplifier. Fine tuning of 1A14L1 is controlled by the loading comparator circuit.

4-80. The rf output from loading coil assembly 1A14 is applied to low-pass filter assembly 1A15 (figure 7-3, sheet 3) that further attenuates harmonics above approximately 44 MHz. A capacitive divider, consisting of 1C54 and 1C55, provides an rf sample at connector 1J3.

4-81. DIRECTIONAL COUPLER 1A16. The rf output from low-pass filter assembly 1A15 is applied through directional coupler 1A16 to the 50-ohm output load. The directional coupler detects forward and reflected power on the transmission line and provides outputs for metering, vswr overload protection, and tune power control.

4-82. The transmission line serves as primary for toroidal transformers 1A16T2 and 1A16T1. The rf current induced in 1A16T2 produces voltages across 1A16R3 and 1A16R4 that are equal in magnitude but 180 degrees different in phase. These voltages are applied to the anodes of diodes 1A16CR3 and 1A16CR4. The rf voltage on the transmission line is coupled by variable capacitors 1A16C8 and 1A16C10 to the cathodes of diodes 1A16CR3 and 1A16CR4, respectively. Capacitors 1A16C8 and 1A16C10 are factory adjusted so the magnitude of the forward wave voltage components is equal to the magnitude of the forward wave current components for a 50-ohm resistive load. When the capacitors are properly adjusted, equal voltages of the same phase are applied to the diode cathodes while equal voltages that are 180 degrees different in phase are applied to the diode anodes. The voltages at the anode and cathode of diode 1A16CR3 are equal in magnitude but opposite in phase. The voltage drop across the diode is the sum of these voltages, or twice the value of each. Therefore, the detector diode produces a resultant dc voltage proportional to the amplitude of the forward wave voltage and current phaser sum. This is the forward power sample output. At the same time the inductively and capacitively coupled voltages across diode 1A16CR4 are of equal magnitude and are in phase. Therefore, zero dc voltage is obtained from diode 1A16CR4. This is the reflected power sample output.

4-83. When a mismatch occurs at the 50-ohm transmission line output, power is reflected; then, the voltages developed across resistors 1A16R3 and 1A16R4 are proportional to the vector sum of the forward wave and reflected wave currents. Similarly, the capacitively coupled voltages at the diode cathodes are proportional to the vector sum of the forward and reflected wave voltage components. The voltage across diode 1A16CR3 is equal to the phaser sum of the forward wave current and voltage components. The voltages applied to diode 1A16CR4 are no longer in phase or of equal magnitude. The voltage across diode 1A16CR4 is equal to the phaser sum of the reflected wave voltage and current components. The resultant dc voltage provides the reflected power sample output. Variable resistors 1A16R5 and 1A16R6 are provided to calibrate the dc output voltage with the forward and reflected power levels.

4-84. The directional coupler detector circuits, which include diodes 1A16CR1 and 1A16CR2, sample the forward and reflected power on the transmission line in the same manner as described above. Diode 1A16CR1 provides a positive dc bias, proportional to the reflected power on the transmission line, that is the vswr overload sensor sample output. Diode 1A16CR2 provides a positive dc bias proportional to the forward power on the transmission line. This voltage is the tune power level sample output and is applied to the internal gain control circuit.

4-85. REFL PWR OVLD potentiometer 1A21R7, located on adjustment panel assembly 1A21 (figure 7-3, sheet 4), provides a threshold voltage for comparison with the vswr overload sensor sample. Comparison is accomplished by vswr overload sensor 1A9A5A6. When the vswr overload sensor sample voltage exceeds the threshold voltage set by 1A21R7, a vswr overload sensor fault signal (logic 1 output) is developed.

4-86. TUNE RESISTOR SWITCH ASSEMBLY 1A25. Tune resistor switch assembly 1A25 is automatically controlled by the 309F-1 Digital to Analog Converter and is activated while the amplifier and the antenna coupler are tuning. The assembly utilizes a resistive network and performs two functions. First, while the power amplifier is tuning, the assembly limits the vswr seen by the power amplifier to 2:1. Then, when the amplifier is tuned and 1-kW output power is applied, the assembly limits the power delivered to the antenna coupler to 250 watts. When the antenna coupler is tuned, the resistive network in the assembly is removed by a control signal from the 309F-1 Digital to Analog Converter and the power amplifier is connected directly to the antenna coupler. The full 2.5-kW output power is then applied.

4-87. The resistive network (R5, R6, R7, and R8) is switched into the circuit when relay 1A25K1 is energized. A signal from the 309F-1 Digital to Analog Converter places a logic 1 on the tune resistor control line. This logic 1 turns on transistor 1A25Q1 that energizes relay 1A25K1. This relay remains energized and the resistors remain in the circuit until both the power amplifier and the antenna coupler are tuned. The 309F-1 Digital to Analog Converter places a logic 0 on the tune resistor control line when this tuning is complete. The logic 0 turns off transistor 1A25Q1. Relay 1A25K1 is thus deenergized, the resistors are switched out of the circuit, and the power amplifier is connected to the antenna coupler through the resistor switch assembly.

4-88. The output impedance of the power amplifier is 50 ohms. The vswr seen by the amplifier is limited to 2:1 by limiting the effective shunt load impedance connected to the amplifier output. This impedance must be between 25 and 100 ohms to maintain the 2:1 vswr limit.

4-89. The impedance of the antenna coupler, while it is tuning, may vary from zero (short circuit) to infinity (open circuit). If the antenna coupler becomes a short circuit, the 100-ohm resistors, R5

and R6, in the tune resistor switch assembly are connected in parallel with the 200-ohm resistors, R7 and R8. This results in an effective shunt load impedance of 33-1/3 ohms. If the antenna coupler becomes an open circuit, the effective shunt load impedance is the 200-ohm resistors, R7 and R8, connected in parallel. This results in an effective shunt load impedance of 100 ohms. Therefore, the effective shunt load impedance is always within the limits of 25 and 100 ohms and the desired vswr limit of 2:1 is maintained.

4-90. SIGNAL CONTROL CIRCUITS.

4-91. The 208U-3A Amplifier-Power Supply Group signal control circuits include keying circuits, automatic level control circuits, and transmitter gain control circuits. The keying circuits connect the transmitter to the antenna and control the bias of the driver and power amplifiers. The automatic level control circuits supply bias to control the level of the external exciter. The transmitter gain control circuits supply bias to control the gain of the external exciter.

4-92. KEYING. Keying the transmitter performs two functions: It connects the transmitter output to the antenna and reduces below cutoff the negative bias applied to the control grids of driver amplifier 1A1V2 and power amplifier 1V1.

4-93. When the transmitter is keyed, a logic 1 on the power amplifier key line turns on transistor 1A22Q1 (figure 7-3, sheet 3). Transistor 1A22Q1 applies a positive voltage to the base of transistor 1A22Q1 which then provides a ground to transmit-receive relay 1A22K1. (Relay 1A22K2 is also energized, grounding the receiver through capacitor 1A22C9.) Energizing 1A22K1 disconnects the receiver from the antenna and connects the transmitter output to the antenna. Another set of contacts on the transmit-receive relay is closed when the relay is energized, applying the logic 1 on the power amplifier key line to the delayed key-enable interlock line. Zener diode 1A22CR1 protects the transmit-receive relay.

4-94. A logic 1 on the delayed key-enable interlock line turns on key relay driver transistor 2A7A2A1 (figure 7-4, sheet 2), which then provides a ground for key relay 2A7K1. Energizing 2A7K1 connects a voltage divider across the power amplifier grid bias output and provides a current path to ground for zener regulator 2A7A2CR5 in the driver amplifier grid bias supply. This reduces the power amplifier grid bias from -1100 Vdc cutoff voltage to about -900 Vdc operating bias (-300 Vdc with respect to the power amplifier cathode). The driver grid bias is reduced from about -70 Vdc cutoff bias to between -30 and -13 Vdc operation bias.

4-95. INTERNAL GAIN CONTROL. (Refer to figure 4-6.) The internal gain control (IGC) circuits protect the equipment from overdrive, mistuning, or improper loading conditions. The IGC circuits also control the forward power output of the power amplifier during the automatic tune cycle by controlling the control grid bias level of input amplifier tube 1A1V1. The IGC circuit operates independently of other external gain control circuits, such as ALC or TGC, and under normal operating conditions, is inactive.

4-96. During normal operation, IGC control amplifier 1A9A5Q2 is saturated. This provides normal biasing to the input amplifier control grid. Any input to IGC preamplifier 1A9A5A8 drives the IGC amplifier from saturation toward cutoff, increasing (making more negative) the bias voltage on the control grid of input amplifier 1A1V1. The IGC preamplifier is controlled by the following five inputs:

a. Automatic Load Control (ALC). A delayed ALC level greater than -10 Vdc reduces the amplifier gain. This sample protects the final amplifier from excessive screen dissipation (light loaded conditions) during tuning.

b. Anode Dissipation Limiter (ADL). The ADL circuit compares a sample of power amplifier dc plate current and a sample of detected power amplifier rf plate voltage. If the dc plate current sample increases faster than the sample of rf plate voltage, the ADL circuit applies a controlling voltage to the IGC circuit.

c. Tune Power. A sample of delayed power from the directional coupler controls the amplifier gain during a tune cycle.

d. Key Line. In the unkeyed condition, a voltage applied to the IGC drives the input amplifier to cutoff.

e. Driver Grid Overdrive. A sample of delayed driver grid rf voltage controls the IGC circuit to prevent excessive driver grid current due to overdrive during a tune cycle.

4-97. ANODE DISSIPATION LIMITER. The anode dissipation limiter (ADL) compares a sample of power amplifier tube plate current with a sample of power amplifier rf voltage. When an increase in power amplifier plate current is not accompanied by a proportionate increase in plate rf voltage, the ADL applies a controlling voltage to the IGC circuits.

4-98. A sample of power amplifier plate rf voltage is applied through a capacitive voltage divider to power amplifier plate detector 1A17V1B. The rf voltage sample is filtered and applied to ADL amplifier 1A9A5A7. ADL RF PL V potentiometer 1A21R9 is adjusted to the point where the anode dissipation limiter provides threshold IGC amplifier bias at 2.5-kW rf power output. The power amplifier plate rf voltage sample is also applied to the base of rf prove transistor 1A21Q3. When rf is present on the power amplifier plate (during

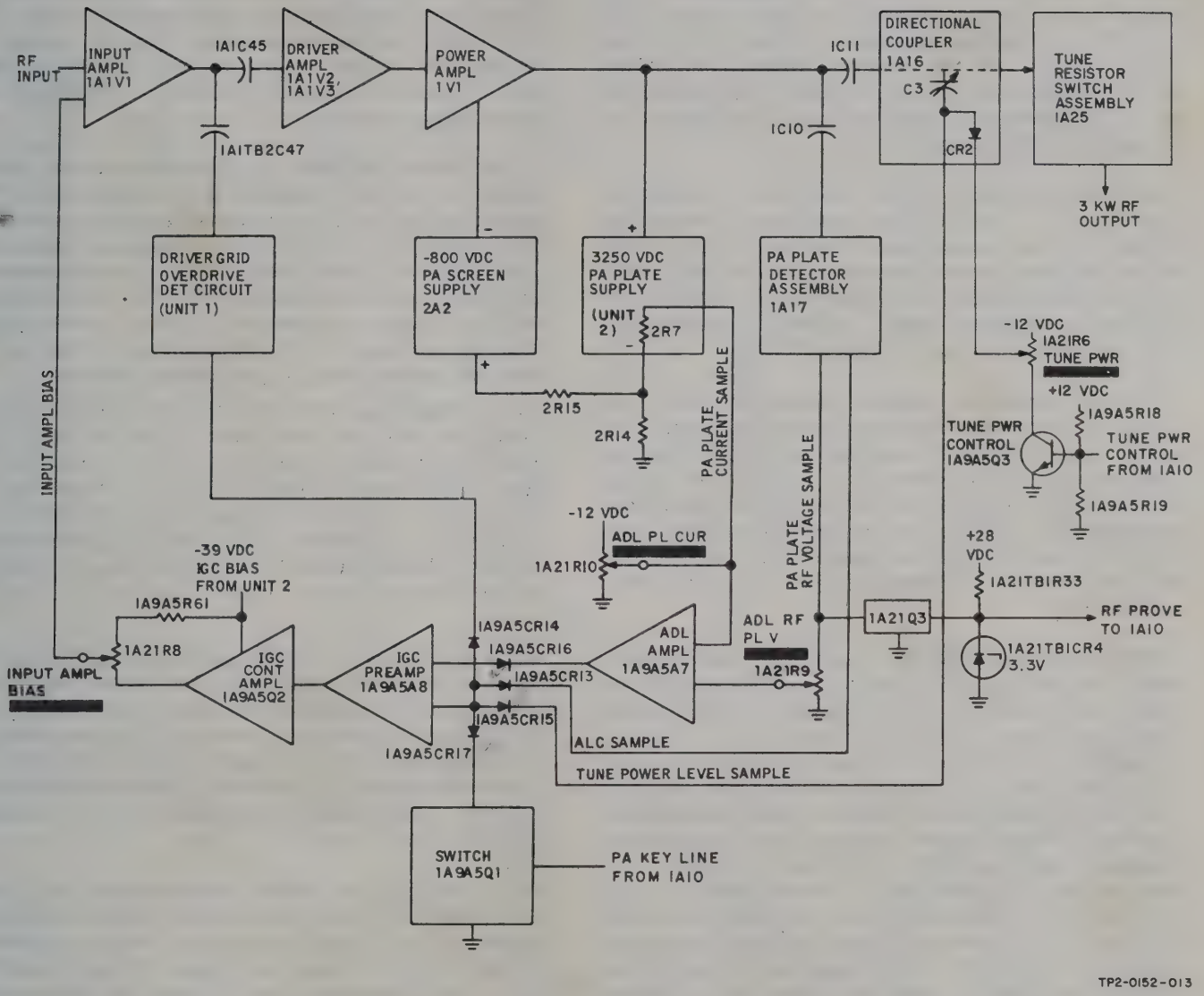


Figure 4-6. Internal Gain Control, Block Diagram

tune cycle) a positive voltage is applied to 1A21Q3. This places a ground (logic 0) on the rf prove line. If, for any reason, rf is not present on the power amplifier plate, 1A21Q3 will cut off, zener diode 1A21CR4 will limit the +28 Vdc applied to 3.3 Vdc, and a logic 1 will be placed on the rf prove line.

4-99. A sample of power amplifier plate current is applied to ADL amplifier 1A9A5A7. ADL PL CUR potentiometer 1A21R10 is adjusted for proper plate current threshold to establish threshold IGC amplifier bias at 2.5-kW rf power output.

4-100. ADL amplifier 1A9A5A7 senses the increases in power amplifier plate rf voltage and power amplifier plate current. If the increase of the two is not proportionate, a controlling voltage is applied to the IGC preamplifier that drives the IGC amplifier. The IGC amplifier places more bias on the control grid of the input amplifier and thereby reduces the rf signal applied to the control grid of the power amplifier tube.

4-101. DRIVER GRID OVERDRIVE CONTROL. A sample of driver grid voltage is applied from the control grid of driver amplifier 1A1V2 through a driver grid overdrive detector circuit to IGC preamplifier 1A9A5A8. The detector circuit filters and detects the grid voltage sample. A zener diode in the circuit blocks the grid voltage sample until it has reached +6.8 Vdc. Any voltage above +6.8

Vdc will act as a controlling voltage for the IGC preamplifier and IGC will be initiated.

4-102. TUNE POWER LEVEL. A sample of the tune power level is applied from directional coupler 1A16 to IGC preamplifier 1A9A5A8. If the level of tune power rises above the threshold level set by TUNE PWR potentiometer 1A21R6 (during tune cycle), the IGC preamplifier accepts the rise as a controlling voltage, and IGC is initiated.

4-103. AUTOMATIC LOAD CONTROL. (Refer to figure 4-7.) The 208U-3A Amplifier-Power Supply Group provides an automatic load control (ALC) bias to the system exciter gain control circuit. ALC bias prevents overdrive on input signal peaks by controlling the rf input signal. Power output capability is still provided at near maximum rating.

4-104. A sample of rf signal voltage is taken from the power amplifier tube plate circuit and applied to power amplifier plate detector diode 1A17V1A. A positive ALC delay voltage is applied to the cathode of 1A17V1A. An ALC control sample is taken from the plate of 1A17V1A and applied through resistor 1A17R3, coil 1A17L3, and capacitor 1A17C12 to the IGC preamplifier located in internal control amplifier 1A9.

4-105. When the 208U-3A Amplifier-Power Supply Group is set for high-power operation, ALC/TGC select relay 1A21K1 is automatically switched to the ALC position and ALC/TGC transfer relay 1A21K2 is automatically switched to the high position. The ALC delay bias is obtained from the arm of HIGH PWR ALC potentiometer 1A21R3. When the 208U-3A Amplifier-Power Supply Group is set for low-power operation, relay 1A21K2 is switched to the low position and the ALC delay bias is obtained from the arm of LOW PWR ALC potentiometer 1A21R4. The large ALC delay bias prevents a gain-reducing bias from developing until the power-amplifier is operating near the desired forward power output level for either high- or low-power operation. At the ALC threshold level, the filtered and rectified output is applied through relay 1A21K1 and coil 1A17L1 to the external system exciter gain control circuits.

4-106. For high-power operation, 1A21R3 is normally adjusted so 1A17V1A is biased to the point of threshold at 1/2 dB below the desired power output. A 1.0-dB increase in output power above the point of ALC threshold at 2.5 kW produces a -5 Vdc output. For low-power operation, 1A21R4 is normally adjusted so 1A17V1 is biased to the point of threshold at 1/2 dB below the desired forward power output. A 1.0-dB increase in output power above the point of ALC threshold at 1-1/2 kW produces a -3.5 Vdc ALC output.

4-107. TRANSMITTER GAIN CONTROL. The 208U-3A Amplifier-Power Supply Group transmitter gain control (TGC) circuit provides a negative dc bias voltage to the external system exciter to control the exciter gain. The TGC and ALC circuits perform similar functions. The ALC bias circuit has a fast attack and release time and functions momentarily during periods of peak rf signal voltage inputs. The TGC bias circuit compensates for any change in exciter or power amplifier gain on a long-term basis, such as might be caused by changing the operating frequency.

4-108. When the 208U-3A Amplifier-Power Supply Group is set for high-power operation, ALC/TGC select relay 1A21K1 is automatically switched to the TGC position. A TGC control sample is taken from the cathode of 1A17V1A and applied through a detector and filtering circuit to HIGH PWR TGC potentiometer 1A21R1. The controlling TGC voltage is then applied through the arm of 1A21R1 and relay 1A21K1 to the external system exciter gain control circuits.

4-109. When the 208U-3A Amplifier-Power Supply Group is set for low-power operation, ALC/TGC select relay 1A21K1 stays in the TGC position and ALC/TGC transfer relay 1A21K2 is switched to the low position. The control sample from the cathode of 1A17V1A is applied to LOW PWR TGC potentiometer 1A21R2, through the arm of 1A21R2 and relay 1A21K1, to the external system exciter gain control circuits.

4-110. Potentiometers 1A21R1 and 1A21R2 can be adjusted for maximum negative dc TGC output. This will assure optimum protection regardless of the external exciter used. However, upon connection of an exciter, they should be reset to obtain proper rf power output from the linear power amplifier. During step 3 (fine tune 1) of the automatic tuning sequence, a TGC inhibit signal from the exciter energizes 1A21K3 removing the TGC.

4-111. HIGH/LOW POWER OPERATION. The 208U-3A Amplifier-Power Supply Group can be operated in high- or low-power mode when using an external exciter with TGC and ALC input. Normal operation is in the high-power mode. Relay 1A21K2 provides the necessary switching. The 208U-3A Amplifier-Power Supply Group is set for high-power operation when an rf output level between 1.5 to 2.5 kW is desired. Low-power operation provides an rf output level between 1 to 1.5 kW.

4-112. The TGC output is increased for low-power operation to reduce the exciter gain and maintain power output at a nominal 1.5 kW. The ALC bias is reduced, causing a lower power ALC threshold.

4-113. AUTOMATIC TUNING. (Refer to figure 4-1.)

4-114. The automatic tuning section for the 208U-3A Amplifier-Power Supply Group includes coarse and fine tuning, driver amplifier plate tuning, power amplifier plate primary and secondary tuning, and power amplifier plate loading.

4-115. The 208U-3A Amplifier-Power Supply Group is tuned automatically by four servo loops. The driver servo loop tunes the driver plate tank circuit

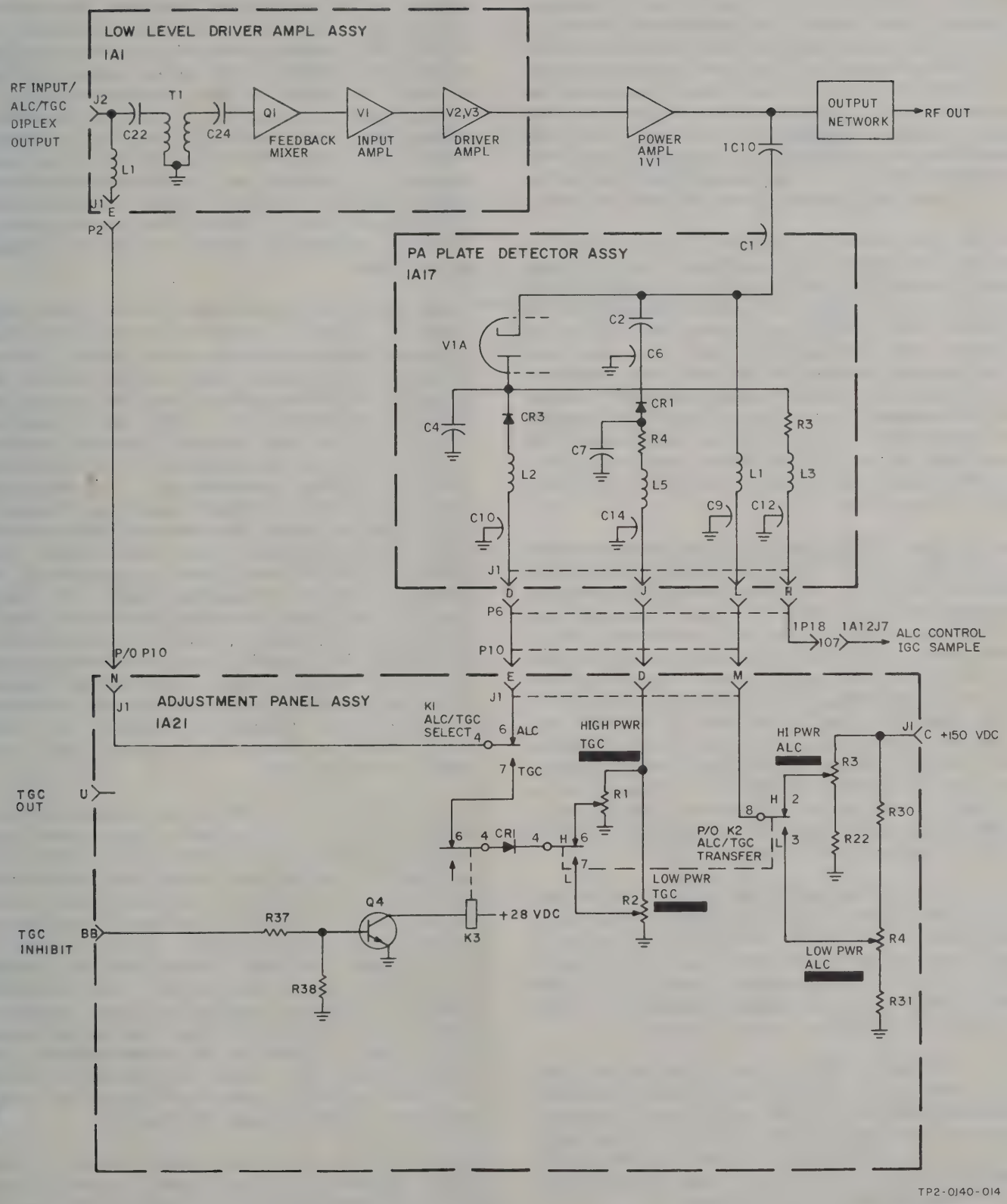


Figure 4-7. ALC/TGC Circuits, Simplified Schematic Diagram

to 180 degrees phase difference between the driver grid voltage and driver plate voltage. The power amplifier plate primary servo loop tunes the primary capacitor and coil and the secondary coil of the power amplifier plate circuit to 180 degrees phase difference between the power amplifier grid voltage and power amplifier plate voltage. The power amplifier secondary servo loop tunes the secondary capacitor of the power amplifier plate circuit to provide 90 degrees phase difference between voltages on the primary and secondary coils of the output network. The power amplifier loading coil servo loop tunes the loading coil to establish a specific gain of the power amplifier.

4-116. Each servo loop consists of the circuit to be tuned, a mechanical drive assembly with a followup potentiometer, a dc servo amplifier, a dc servo preamplifier that contains an error amplifier, and the circuits which develop the coarse and fine tuning voltages that are applied to the error amplifier. Coarse tuning voltages for all four servo loops are developed in the digital-to-analog converter circuits of tune sequence control 1A10. Fine tuning voltages are provided by a separate phase discriminator for each tuned circuit. The mechanical drive assemblies in the primary and loading servo loops contain feedback tachometers.

4-117. The tuned elements are first coarse positioned and then fine tuned. Coarse positioning is achieved at the beginning of each tuning cycle by applying voltages from the digital-to-analog converter circuits and from the followup potentiometer to the error amplifier in each servo loop. The servo motors are driven until the error amplifier inputs balance. Upon completion of coarse positioning, control circuits sequence the power amplifier into the fine tune cycle. This consists of disconnecting coarse tune voltages from the error amplifier and connecting the phase discriminators and the loading comparator. System ground is connected to the error amplifiers for a tuning reference. Fine tuning is then accomplished in three steps at a reduced power level.

4-118. The tachometers in the primary and loading drive units provide a feedback voltage to the error amplifier. The feedback voltage is proportional to the speed of the servo motor and is opposite in polarity to the error amplifier input voltage. The tachometer voltage eliminates variations in servo-loop gain by introducing dynamic damping.

4-119. COARSE TUNING. (Refer to figures 4-8, 4-9, 4-10, and 4-11.) All four servo loops are coarse tuned simultaneously, in the same manner. Separate diagrams are provided for each of the four servo loops, but it will only be necessary to refer to the diagram for the driver tuning loop (figure 4-8) to understand the coarse tuning function.

4-120. Coarse tuning voltages are generated by digital-to-analog converter power supply 1A10A1. The voltages are fixed with respect to one another, but are floating with respect to ground. The relation to ground is controlled by a ladder network in digital-to-analog converter 1A10A2. This can be thought of as two variable resistors connected in series, their value determined by the frequency selected. The ladder network is grounded through an operational amplifier. The ladder network provides a linear dc analog of the frequency selected to voltage shaper 1A9A1. The voltage shaper circuits change the linear input to a roughly logarithmic output that matches the tuning curve of the tuned element. At the same time, 20 V from the digital-to-analog converter circuits is applied across followup potentiometer 1A3R1. The followup potentiometer is connected across the ladder network in a bridge arrangement.

4-121. During the coarse tune portion of the tuning sequence, a logic 1 on the servo mode control line energizes servo mode control relay 1A9A3K2. Energizing the servo mode control relay connects the output of the voltage shaper and the slider of the followup potentiometer to driver error amplifier 1A9A3A3. The error amplifier compares the frequency analog from the voltage shaper with the voltage from the followup potentiometer. Any difference results in an error amplifier output that controls dc servo amplifier 1A8A1. The servo amplifier develops output voltages that drive servo motor 1A3B1. The direction of servo-motor travel is governed by the polarity of the error amplifier inputs. The servo motor is mechanically connected to the driver amplifier plate tank circuit. The servo motor runs until the voltage from the followup potentiometer slider matches the frequency analog from the voltage shaper. When the inputs to the error amplifier are balanced, no error output voltage is developed, the servo motor stops, and the driver amplifier plate tank circuit is coarse tuned.

4-122. FINE TUNING. When coarse tuning is completed, a logic 0 on the servo mode control line deenergizes servo mode control relay 1A9A3K2. Deenergizing the servo mode control relay disconnects the coarse tuning voltages and connects the phase discriminators, loading comparator, and system ground to the error amplifiers. The error amplifiers compare the phase discriminator and loading comparator outputs with ground. Any difference results in an error amplifier output that causes a servo motor to run in the same manner as during coarse tuning. When the phase discriminator and loading comparator outputs are reduced to zero, the error amplifier inputs are balanced, the servo motors stop, and fine tuning is completed.

4-123. DRIVER AMPLIFIER PLATE TUNING. The driver amplifier plate tank circuit consists of coil 1A2L1 and capacitor 1A2C1 in driver-power amplifier interstage network 1A2 (figure 4-1). During the automatic tune cycle the driver plate tank is coarse tuned to near resonance by the coarse tune followup potentiometer. Upon completion of coarse

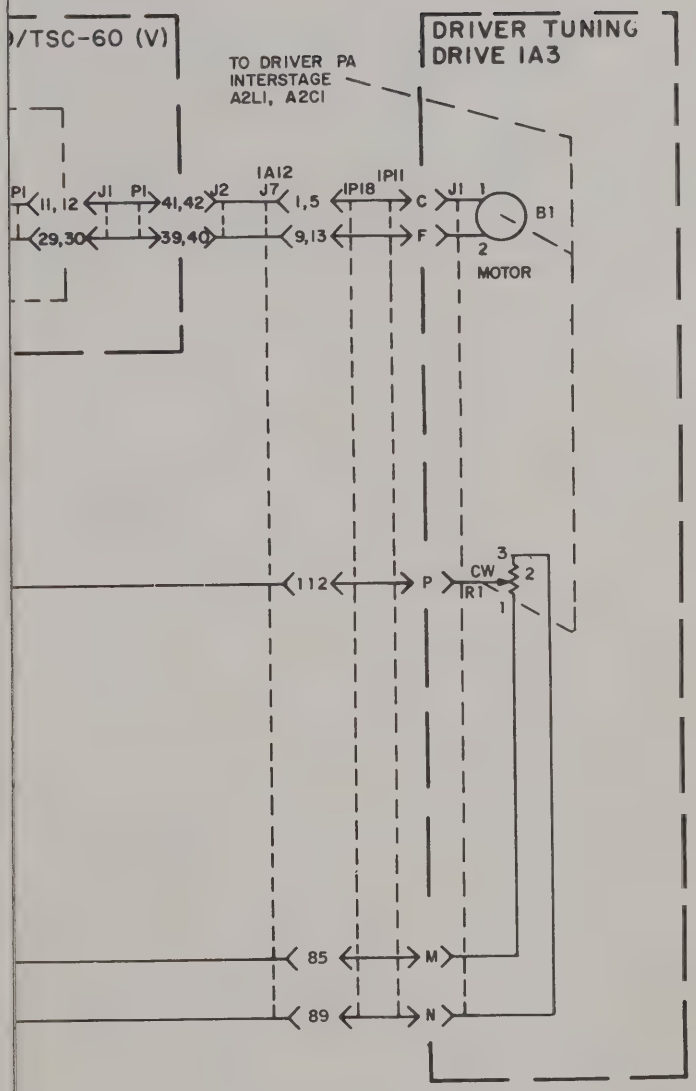


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Figure 4-8. Servo Drive (Driver), Simplified Schematic Diagram

to 180 degrees phase difference between the driver grid voltage and driver plate voltage. The power amplifier plate primary servo loop tunes the primary capacitor and coil and the secondary coil of the power amplifier plate circuit to 180 degrees phase difference between the power amplifier grid voltage and power amplifier plate voltage. The power amplifier secondary servo loop tunes the secondary capacitor of the power amplifier plate circuit to provide 90 degrees phase difference between voltages on the primary and secondary coils of the output network. The power amplifier loading coil servo loop tunes the loading coil to establish a specific gain of the power amplifier.

4-116. Each servo loop consists of the circuit to be tuned, a mechanical drive assembly with a followup potentiometer, a dc servo amplifier, a dc servo preamplifier that contains an error amplifier, and the circuits which develop the coarse and fine tuning voltages that are applied to the error amplifier. Coarse tuning voltages for all four servo loops are developed in the digital-to-analog converter circuits of tune sequence control 1A10. Fine tuning voltages are provided by a separate phase discriminator for each tuned circuit. The mechanical drive assemblies in the primary and loading servo loops contain feedback tachometers.

4-117. The tuned elements are first coarse positioned and then fine tuned. Coarse positioning is achieved at the beginning of each tuning cycle by applying voltages from the digital-to-analog converter circuits and from the followup potentiometer to the error amplifier in each servo loop. The servo motors are driven until the error amplifier inputs balance. Upon completion of coarse positioning, control circuits sequence the power amplifier into the fine tune cycle. This consists of disconnecting coarse tune voltages from the error amplifier and connecting the phase discriminators and the loading comparator. System ground is connected to the error amplifiers for a tuning reference. Fine tuning is then accomplished in three steps at a reduced power level.

4-118. The tachometers in the primary and loading drive units provide a feedback voltage to the error amplifier. The feedback voltage is proportional to the speed of the servo motor and is opposite in polarity to the error amplifier input voltage. The tachometer voltage eliminates variations in servo-loop gain by introducing dynamic damping.

4-119. COARSE TUNING. (Refer to figures 4-8, 4-9, 4-10, and 4-11.) All four servo loops are coarse tuned simultaneously, in the same manner. Separate diagrams are provided for each of the four servo loops, but it will only be necessary to refer to the diagram for the driver tuning loop (figure 4-8) to understand the coarse tuning function.

4-120. Coarse tuning voltages are generated by digital-to-analog converter power supply 1A10A1. The voltages are fixed with respect to one another, but are floating with respect to ground. The relation to ground is controlled by a ladder network in digital-to-analog converter 1A10A2. This can be thought of as two variable resistors connected in series, their value determined by the frequency selected. The ladder network is grounded through an operational amplifier. The ladder network provides a linear dc analog of the frequency selected to voltage shaper 1A9A1. The voltage shaper circuits change the linear input to a roughly logarithmic output that matches the tuning curve of the tuned element. At the same time, 20 V from the digital-to-analog converter circuits is applied across followup potentiometer 1A3R1. The followup potentiometer is connected across the ladder network in a bridge arrangement.

4-121. During the coarse tune portion of the tuning sequence, a logic 1 on the servo mode control line energizes servo mode control relay 1A9A3K2. Energizing the servo mode control relay connects the output of the voltage shaper and the slider of the followup potentiometer to driver error amplifier 1A9A3A3. The error amplifier compares the frequency analog from the voltage shaper with the voltage from the followup potentiometer. Any difference results in an error amplifier output that controls dc servo amplifier 1A8A1. The servo amplifier develops output voltages that drive servo motor 1A3B1. The direction of servo-motor travel is governed by the polarity of the error amplifier inputs. The servo motor is mechanically connected to the driver amplifier plate tank circuit. The servo motor runs until the voltage from the followup potentiometer slider matches the frequency analog from the voltage shaper. When the inputs to the error amplifier are balanced, no error output voltage is developed, the servo motor stops, and the driver amplifier plate tank circuit is coarse tuned.

4-122. FINE TUNING. When coarse tuning is completed, a logic 0 on the servo mode control line deenergizes servo mode control relay 1A9A3K2. Deenergizing the servo mode control relay disconnects the coarse tuning voltages and connects the phase discriminators, loading comparator, and system ground to the error amplifiers. The error amplifiers compare the phase discriminator and loading comparator outputs with ground. Any difference results in an error amplifier output that causes a servo motor to run in the same manner as during coarse tuning. When the phase discriminator and loading comparator outputs are reduced to zero, the error amplifier inputs are balanced, the servo motors stop, and fine tuning is completed.

4-123. DRIVER AMPLIFIER PLATE TUNING. The driver amplifier plate tank circuit consists of coil 1A2L1 and capacitor 1A2C1 in driver-power amplifier interstage network 1A2 (figure 4-1). During the automatic tune cycle the driver plate tank is coarse tuned to near resonance by the coarse tune followup potentiometer. Upon completion of coarse

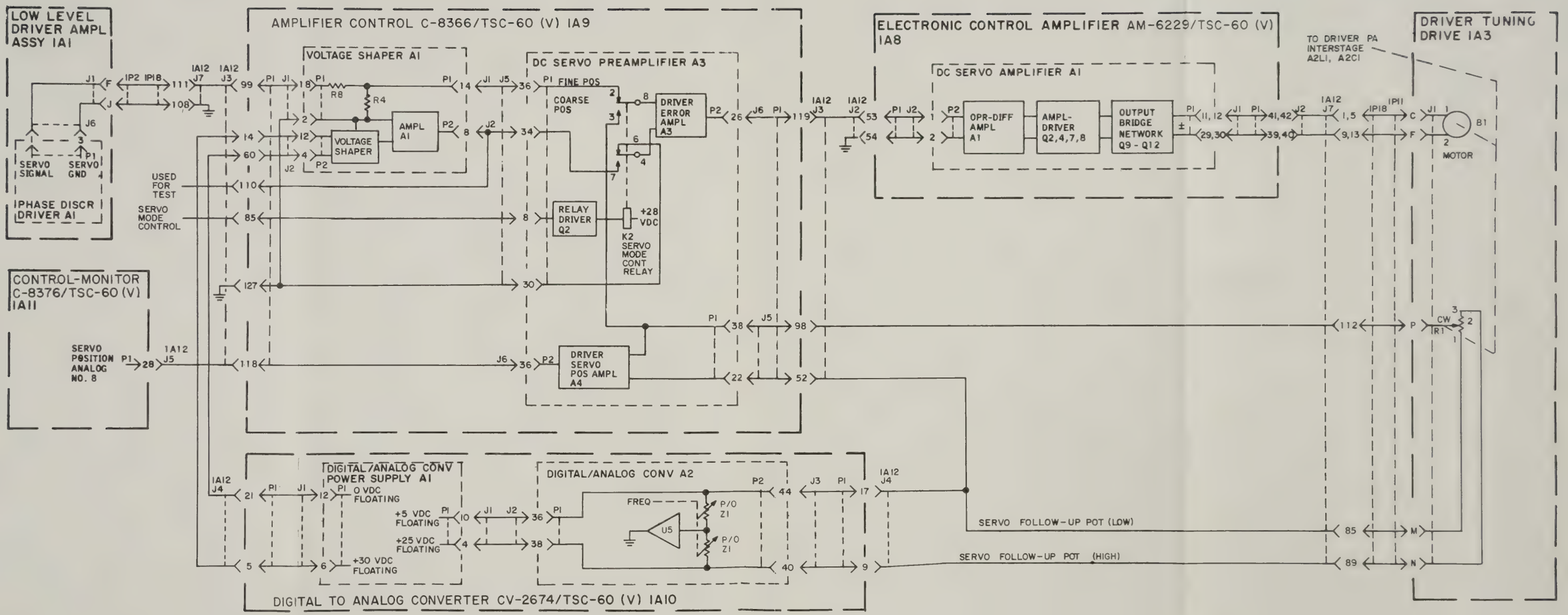

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Figure 4-8. Servo Drive (Driver), Simplified Schematic Diagram

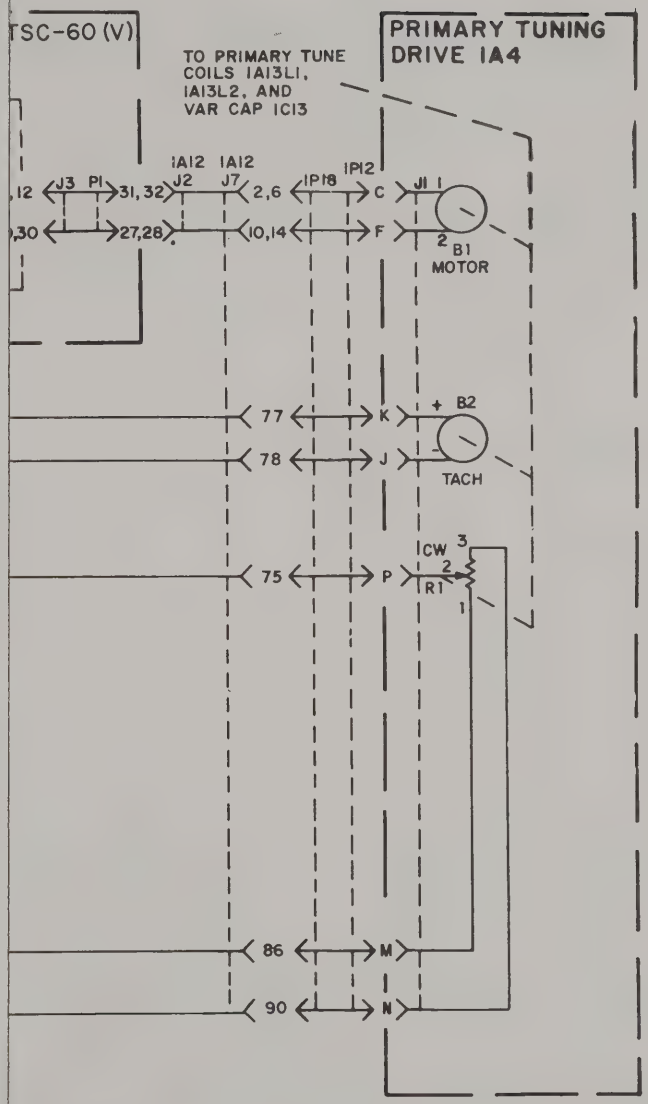

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Figure 4-9. Servo Drive (Primary), Simplified Schematic Diagram

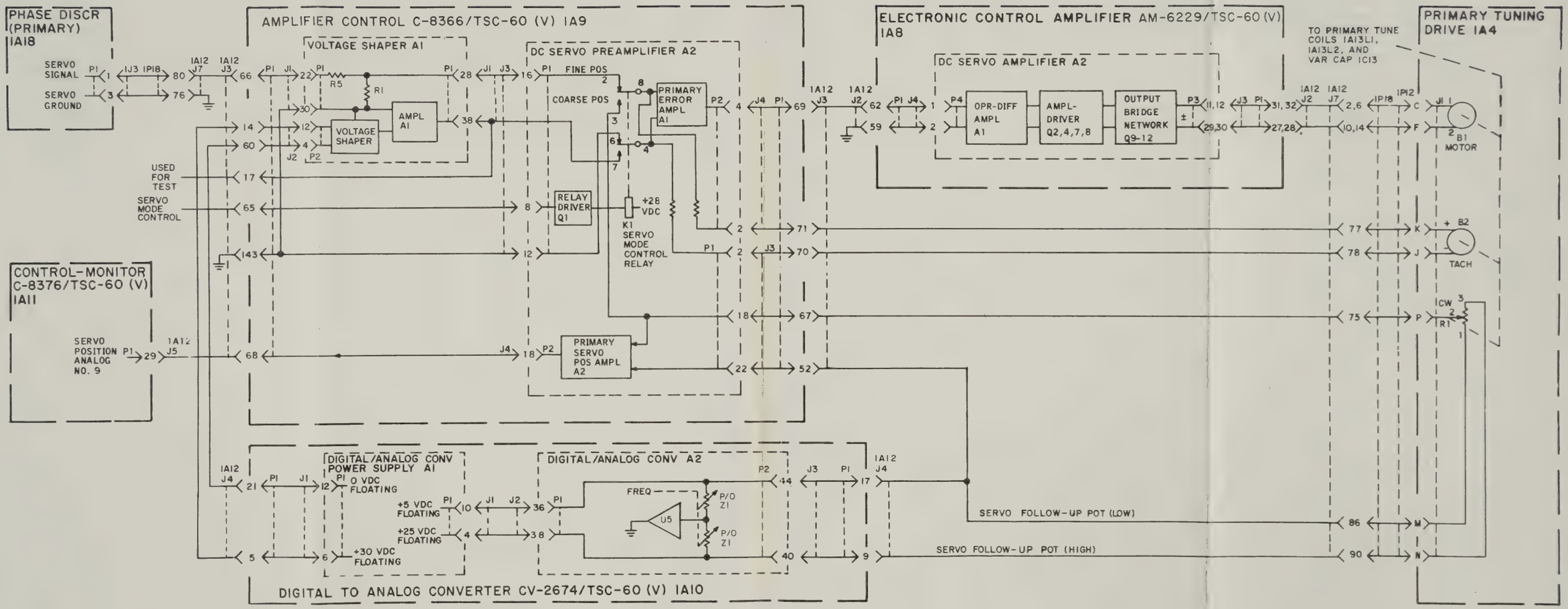

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Figure 4-9. Servo Drive (Primary), Simplified Schematic Diagram

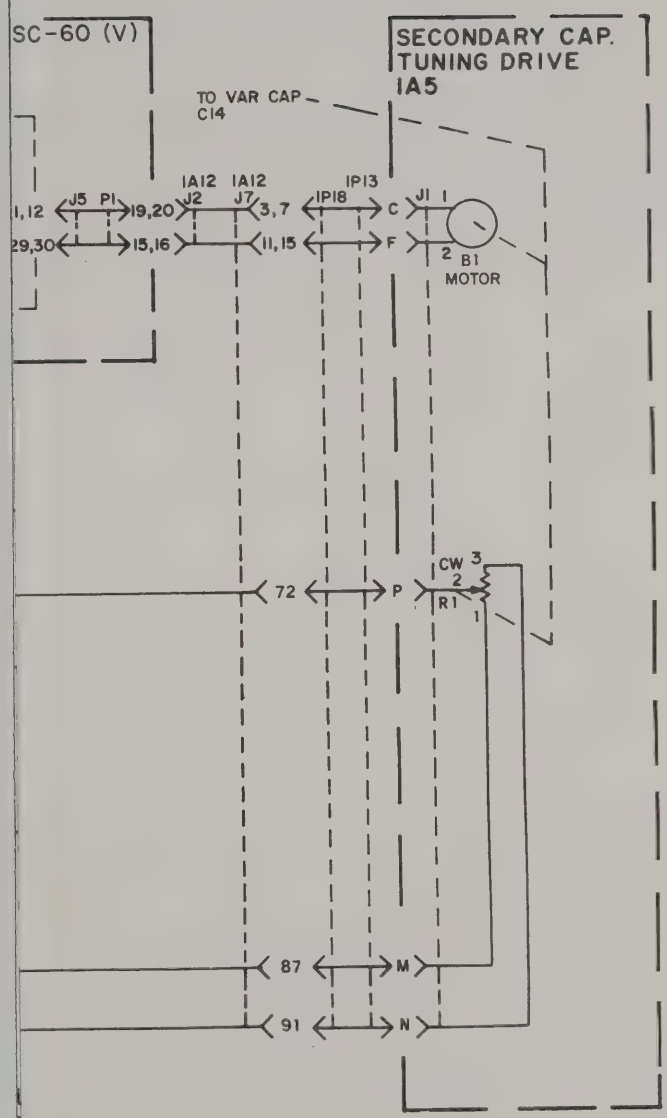

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Figure 4-10. Servo Drive (Secondary), Simplified Schematic Diagram

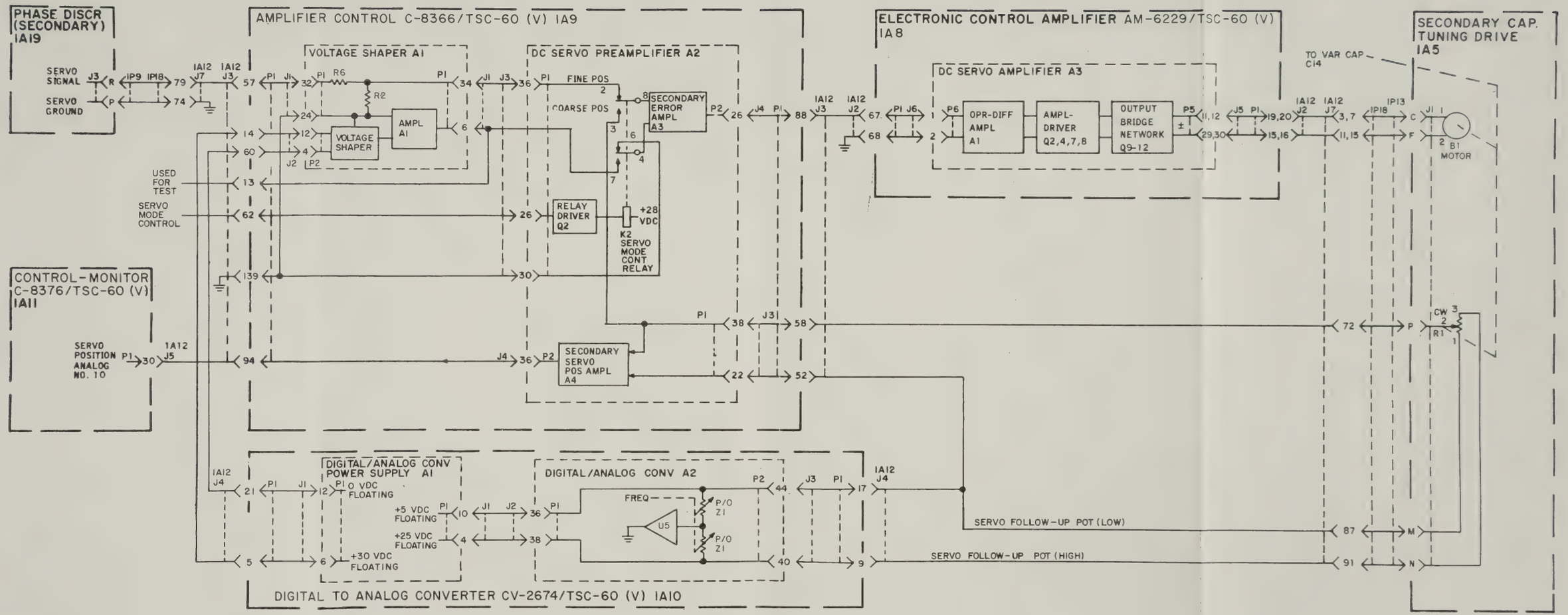

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Figure 4-10. Servo Drive (Secondary), Simplified Schematic Diagram

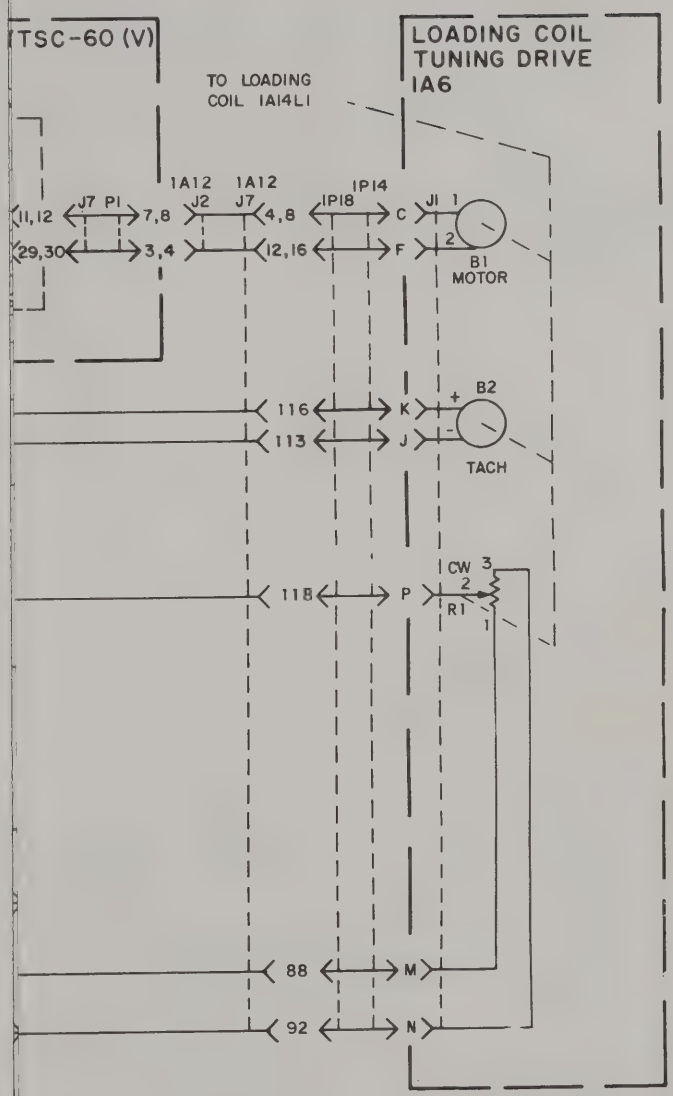

Figure 4-11. Servo Drive (Loading), Simplified Schematic Diagram

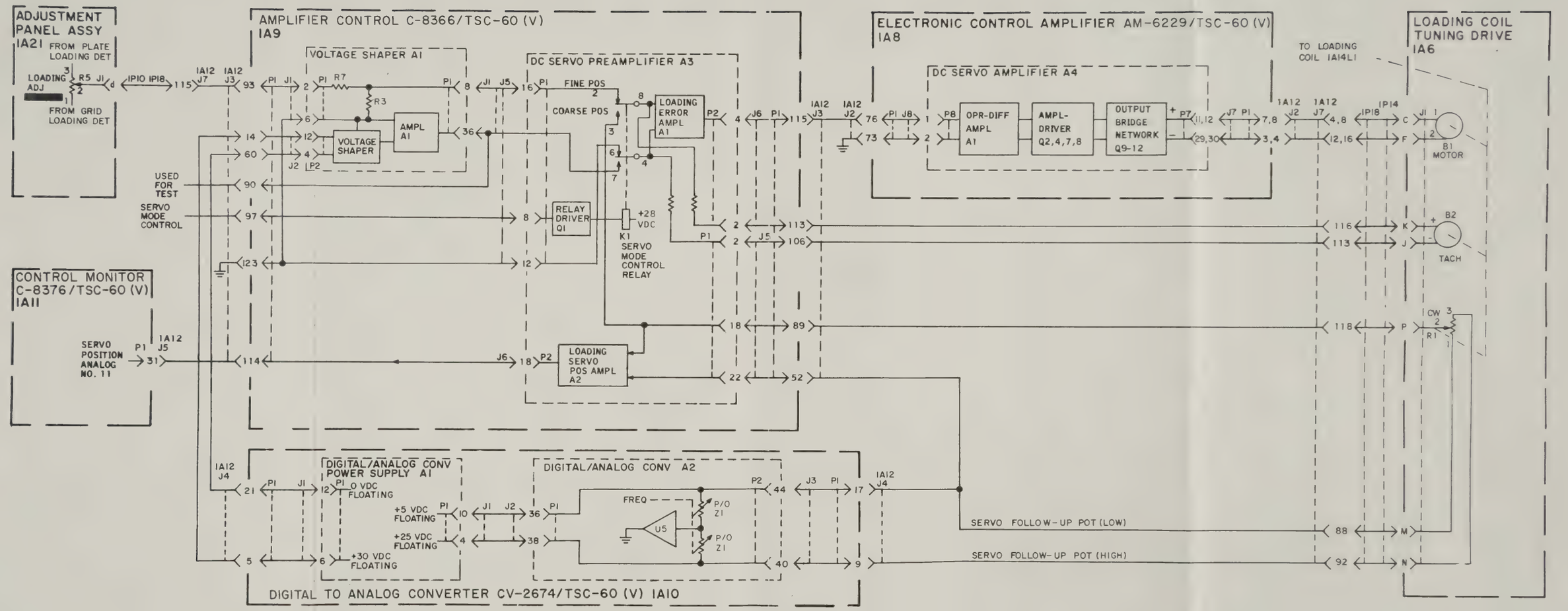

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Figure 4-11. Servo Drive (Loading), Simplified Schematic Diagram

tuning, the driver plate tank is fine tuned to resonance by driver tune discriminator 1A1A1 and driver tuning drive 1A3. The phase discriminator circuit in 1A1A1 compares the phase relationship between the driver grid and driver plate voltages. A dc output is generated if the plate tank is not tuned to resonance (180 degrees out of phase with the grid). The dc output is used to control driver tuning drive 1A3 which drives 1A2L1 and 1A2C1.

4-124. Driver tune discriminator 1A1A1 (figure 7-3, sheet 1) is a conventional 90-degree phase discriminator. The quadrature sample for the discriminator is obtained from the driver amplifier control grid circuit through resistor 1A1R16 and capacitor 1A1C49, and is applied to junction of capacitors 1A1A1C2 and 1A1A1C3. Resistor 1A1R16 and capacitor 1A1C49 compensate for small tuning error due to phase shift in the discriminator. The driver amplifier plate tank is coupled to the discriminator through toroid 1A2T1 to resistors 1A1A1R3 and 1A1A1R4. The discriminator is referenced to ground through capacitor 1A1A1C1.

4-125. The circulating current in coil 1A2L1 lags the voltage across it by 90 degrees. This current induces a voltage in toroid 1A2T1. Because the impedance of the secondary circuit is primarily the inductive reactance of the toroid, the secondary current through the toroid is in phase with the circulating current in the tank inductor. The secondary current produces voltage across resistors 1A1A1R3 and 1A1A1R4 which are 90 degrees out of phase with the voltage across the tank circuit. The driver grid input develops voltages across resistors 1A1A1R5 and 1A1A1R6. When the driver plate tank is tuned to resonance (180 degrees out of phase with the driver grid) the discriminator input voltages are 90 degrees out of phase, and the voltages across diodes 1A1A1CR1 and 1A1A1CR2 are equal in magnitude; then, the dc currents in the diode loads are equal and flowing in opposite directions to produce zero output. When the discriminator input voltages are not exactly 90 degrees out of phase, the voltages across the diodes are not equal and a dc output is produced. The polarity of the output depends on whether the plate tank is above or below resonance.

4-126. The driver phase discriminator output is applied to driver error amplifier 1A9A3A3 (figure 4-8) where it is compared with ground. Any difference results in an error amplifier output that controls dc servo amplifier 1A8A1. The servo amplifier develops output voltages that drive servo motor 1A3B1. The direction of servo-motor travel is governed by the polarity of the phase discriminator output. The servo motor is mechanically connected to coil 1A2L1 and capacitor 1A2C1. When the tank circuit is tuned to resonance, the phase discriminator output is reduced to zero and the servo motor stops.

4-127. POWER AMPLIFIER PLATE PRIMARY TUNING. The power amplifier plate tuning network consists of capacitor 1C13 and coils 1A13L1 and 1A13L2 (figure 4-1). During the automatic tune cycle, the power amplifier plate tuning circuit is coarse tuned to near resonance by the coarse tune followup potentiometer. Upon completion of coarse tuning, the power amplifier plate is fine tuned to resonance by power amplifier primary tune discriminator 1A18 and plate primary tuning drive 1A4. The phase discriminator circuit in 1A18 compares the phase relationship between the power amplifier grid and power amplifier plate voltages. A dc output is generated if the plate circuit is not tuned so it is 180 degrees out of phase with the grid. The dc output is used to control plate primary tuning drive 1A4 which drives 1C13, 1A13L1 and 1A13L2.

4-128. Power amplifier primary tune discriminator 1A18 (figure 7-3, sheet 2) is identical to, and operates the same as, driver tune discriminator 1A1A1. The power amplifier grid is coupled to the discriminator through toroid 1A2T2 to resistors 1A18R3 and 1A18R4. The quadrature sample for the discriminator is obtained from the power amplifier plate through a capacitive voltage divider formed by 1C9 and 1C34. The plate sample is applied to the discriminator through capacitors 1A18C2 and 1A18C3. The dc output obtained when the power amplifier plate tuning network is off resonance is applied to primary error amplifier 1A9A2A1 (figure 4-9) where it is compared with ground. The error amplifier output controls dc servo amplifier 1A8A2. The servo amplifier develops voltages that drive servo motor 1A4B1. The servo motor drives capacitor 1C13 and coils 1A13L1 and 1A13L2 until the phase discriminator output is zero and the power amplifier plate circuit is tuned.

4-129. POWER AMPLIFIER SECONDARY TUNING. The power amplifier secondary capacitor, 1C14, (figure 4-1) is adjusted to produce 90 degrees phase difference between the voltages across the primary and secondary plate tuning coils 1A13L1 and 1A13L2. During the automatic tune cycle the secondary capacitor is coarse tuned by its coarse tune followup potentiometer. Upon completion of coarse tuning, the secondary capacitor is fine tuned by power amplifier secondary tuning discriminator 1A19 and secondary capacitor tuning drive 1A5 (figure 7-3, sheet 2). The phase discriminator circuit in 1A19 compares the phase relationship between coils 1A13L1 and 1A13L2. A dc output is generated if the coils are not 90 degrees different in phase. The dc output is used to control secondary capacitor tuning drive 1A5 that drives secondary tuning capacitor 1C14. The rf voltage from the primary side of primary tune coil assembly 1A13 is coupled through a capacitive voltage divider consisting of capacitors 1C35 and 1C20 to the primary of 1A19T1. The secondary of 1A19T1 develops a voltage across resistor 1A19R1 that is applied to diodes 1A19CR1 and 1A19CR2. The rf voltage from the secondary of primary tune coil assembly 1A13 is coupled through a capacitive voltage divider consisting of capacitors 1C16 and 1C21 to the primary of 1A19T2. The secondary of 1A19T2 develops a voltage across resistor 1A19R2. When

the voltage across 1A13L2 is 90 degrees out of phase with the voltage across 1A13L1, the dc currents in the diode loads are equal and opposite, and no output is produced. When the voltages across the primary and secondary of primary tune coil assembly 1A13 are above or below resonance, the voltages across the diode loads of the phase discriminator are no longer equal and a dc output is produced. The dc output obtained is applied to secondary error amplifier 1A9A2A3 (figure 4-10) where it is compared with ground. The error amplifier output controls dc servo amplifier 1A8A3. The servo amplifier produces voltages that drive servo motor 1A5B1. The servo motor drives secondary tuning capacitor 1C14 until the phase discriminator output is zero and the power amplifier plate tuning is complete.

4-130. POWER AMPLIFIER PLATE LOADING. Power amplifier plate loading coil 1A14L1 (figure 4-1) is adjusted to provide a specific voltage gain of the power amplifier. During the automatic tune cycle, the loading coil is coarse positioned by its coarse tune followup potentiometer. Upon completion of coarse positioning, the loading coil is fine tuned by the power amplifier plate loading comparator circuit. The loading comparator circuit compares the amplitude of the rf voltages on the power amplifier grid and plate. A dc output is obtained if loading conditions are not correct. The dc output is used to control loading coil tuning drive 1A6 that drives loading coil 1A14L1 and switches 1A14S1 and 1A14S2.

4-131. The rf detector at the power amplifier grid, which consists of diode 1A20CR1 and resistor 1A20R3 (figure 4-12), produces a dc voltage proportional to the rf input voltage. The dc output is applied to one end of LOADING potentiometer 1A21R5 through resistor 1A21R13. The rf detector at the power amplifier plate, which consists of diode 1A17CR2 and resistor 1A17R6, produces a dc voltage proportional to the rf output voltage. The dc output is applied to the opposite end of LOADING potentiometer 1A21R5 through resistor 1A21R14. The polarities of diodes 1A20CR1 and 1A17CR2 are reversed so that the dc voltages applied to opposite ends of LOADING potentiometer 1A21R5 are of opposite polarity. Under correct loading conditions, the wiper arm of potentiometer 1A21R5 is adjusted to the point along the potentiometer where the dc voltage is zero. Under light loading conditions, the positive dc output of the plate rf detector increases with respect to the negative dc output of the grid rf detector. As a result, the potential at the wiper arm of LOADING potentiometer 1A21R5 becomes positive. Under heavy loading conditions the opposite is true, and the potential at the wiper arm becomes negative. The dc output obtained from the wiper arm is applied to loading error amplifier 1A9A3A1 (figure 4-11) where

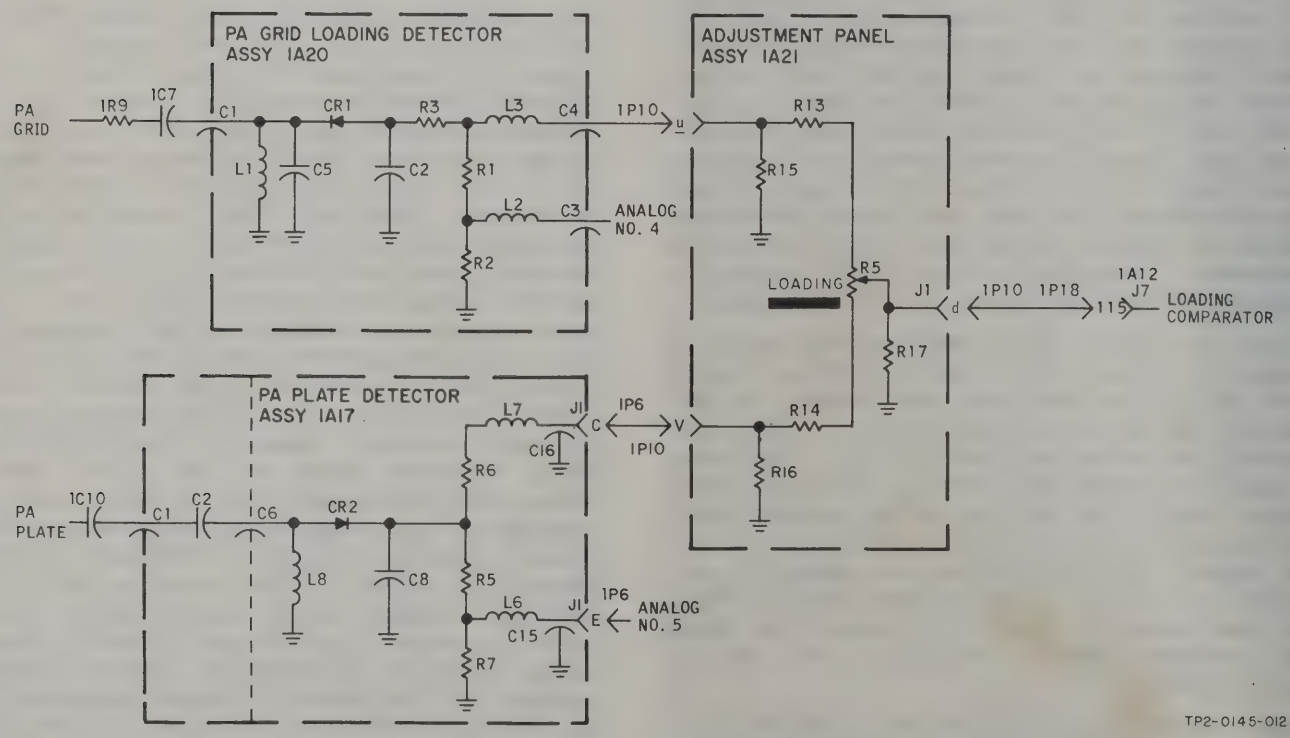

Figure 4-12. Loading Comparator, Simplified Schematic Diagram

it is compared with ground. The error amplifier output controls dc servo amplifier 1A8A4. The servo amplifier produces voltages that drive servo motor 1A6B1. The servo motor drives loading coil 1A14L1 and switches 1A14S1 and 1A14S2 until the power amplifier loading coil is adjusted to provide proper voltage gain, and zero output is obtained from the loading comparator circuit.

4-132. The power amplifier grid and plate rf detector outputs also include voltage dividers that provide grid and plate rf voltmeter samples for metering.

4-133. POWER SUPPLY, UNIT 2.

4-134. The power supply unit provides the operating voltages required by the rf amplifier unit. The detailed theory of operation for the power supply units is divided into the following functional elements: voltage regulation and associated circuits, +28-Vdc supply, cooling air supply, filament supply, high-voltage supplies (power amplifier plate, power amplifier screen, and low-level supplies), and the bias-key supply.

4-135. PA FILAMENT VOLTAGE REGULATION. (Refer to figure 4-13.) The input voltage regulation circuits and associated components include power line filters 2FL1, 2FL2, and 2FL3; main circuit breaker 2CB1; boost transformer 2T6; variable transformer 2T5; transformer 2A3T1, regulator sensor 2A3A1, LINE VOLTAGE REGULATOR ADJUST potentiometer 2R19 and resistor 2R24; regulator drive unit 2A5; regulator disable switch 2S2; filters FL8 and FL9; and servo control circuits in 1A9.

4-136. The 200- to 250-Vac, 3-phase, 47- to 63-Hz or 380- to 420-Hz primary input power is applied through filters 2FL1, 2FL2, and 2FL3 and main circuit breaker 2CB1 to boost transformer 2T6. Filters 2FL1, 2FL2, and 2FL3 protect the input power lines from rf radiation. MAIN circuit breaker 2CB1 protects the primary wiring and the power amplifier filament voltage regulator. Boost transformer 2T6 provides a regulated output voltage.

4-137. The purpose of regulating this voltage is to provide a 225-Vac line-to-line power source for the power amplifier tube filament transformer. The voltage regulation circuits detect sustained variations in line voltage and compensate for such variations by controlling a motor-driven variable transformer.

4-138. The input voltage is regulated by single-phase boost transformer 2T6 and single-phase variable transformer 2T5. When the input voltage is above 225 Vac, 2T5 is driven to produce a voltage in 2T6 that is out of phase with the input voltage. This causes a voltage drop across 2T6 that compensates for the high input voltage. When the input voltage is low, 2T5 is driven to produce a voltage in 2T6 that is in phase with the input voltage. This causes a rise in voltage across 2T6 and compensates for the low input voltage.

4-139. Variable transformer 2T5 is controlled by regulator sensor 2A3A1. The output of 2T6 is applied to isolation transformer 2A3T1. The 65-Vac center-tapped output of 2A3T1 is applied to an rms charging circuit for capacitor 2A3A1C1. Capacitor 2A3A1C1 is discharged exponentially through resistors 2A3A1R6, 2R19, and 2R24 to a -5.6-Vdc zener reference voltage. A dc output voltage, directly proportional to the true rms output of boost transformer 2T6, is obtained from the wiper of LINE VOLTAGE REGULATOR ADJUST potentiometer 2R19.

4-140. LINE VOLTAGE REGULATOR ADJUST potentiometer 2R19 is set to provide 0 Vdc output at 225 Vac input. If the output of 2T6 varies above or below 225 Vac, a corresponding output from the slider of 2R19 above or below zero is applied to error amplifier 1A9A6A1. The error voltage is processed by primary power regulator control 1A9A6 and an output is obtained that controls dc servo amplifier 1A9A7. The output of 1A9A7 drives servo motor 2A5B1 in regulator drive unit 2A5.

4-141. Servo motor 2A5B1 is mechanically linked to variable transformer 2T5. When 2A5B1 is driven by 1A9A7, 2T5 is repositioned to adjust the output of 2T6.

4-142. The net effect is that any deviation from 225-Vac true rms output from 2T6 generates an error voltage output from the wiper of 2R19. The error voltage causes servo motor 2A5B1 to reposition variable transformer 2T5 as necessary to maintain a constant 225-Vac output from 2T6.

4-143. Regulation is accomplished within 10 seconds of primary input voltage variation. Short duration transients of ±20 percent of nominal power line voltage are accepted without damage.

4-144. Regulator drive unit 2A5 contains switches 2A5S1B and 2A5S2B that limit the travel of servo motor 2A5B1 and variable transformer 2T5. When the line input voltage drops so low that 2T5 can no longer maintain a 225-Vac output from 2T6, load voltage maximum limit switch 2A5S1B opens. Opening 2A5S1B breaks the return path of the +28 Vdc that drives servo motor 2A5B1. Diode 2A5CR1 permits application of +28 Vdc in the opposite direction to restore normal operation of 2A5B1 when the line input voltage returns to the operating range. Switch 2A5S2B limits compensation for high input voltage in a similar manner. When the limits of compensation are exceeded, switch 2A5S1A or 2A5S2A operates to remove a ground from the regulator fault monitor line. When the path to ground is removed, a logic 1 on the regulator fault monitor line indicates a voltage regulation fault. Regulator disable switch 2S2 disables regulator drive unit 2A5 by opening the

drive voltage path to servo motor 2A5B1. T-section filters 2FL8 and 2FL9 limit rf radiation on the drive voltage line.

4-145. +28-VOLT DC SUPPLY. The +28-Vdc supply consists of CONTROL POWER circuit breaker 2CB2, +28-Vdc supply transformer 2T4, +28-Vdc supply 2A1, and filters 2FL4 through 2FL7 (figure 7-4, sheet 2).

4-146. Three-phase 225-Vac power is applied through CONTROL POWER circuit breaker 2CB2 to the delta-connected primary of +28-Vdc supply transformer 2T4. Circuit breaker 2CB2 protects transformer 2T4 and rectifier 2A1CR1 against fault or overload. Transformer 2T4 is a voltage stepdown power transformer. The output of the Y-connected secondary winding of 2T4 is applied to 3-phase full-wave bridge rectifier 2A1CR1. No filtering of the +28-Vdc output developed across 2A1CR1 is necessary. The +28-Vdc output is applied to contactors in the power supply, unit 2, and to servos and relays in rf amplifier, unit 1.

4-147. A +20-Vdc output is derived from a filter consisting of resistors 2A1R1, 2A1R2, and 2A1R3 and capacitors 2A1C1, 2A1C2, and 2A1C3. The +20-Vdc output is regulated by zener regulator 1A1CR6 in the rf amplifier, unit 1, and is applied to the collector of feedback mixer amplifier 1A1Q1.

4-148. Resistors 2A1R4, 2A1R5, and 2A1R6 and capacitor 2A1C4 provide a metering sample output. The 225 Vac from CONTROL POWER circuit breaker 2CB2 is also applied to transformer 1T3 that provides power to the 652J-13 Power Supply 1A7.

4-149. COOLING AIR SUPPLY. The cooling air supply consists of blower contactor driver 2A3A2Q2, blower contactor 2K2, and cooling air assembly 2A6 (figure 7-4, sheets 1 and 2).

4-150. A logic 1 on the blower control input turns on blower contactor driver 2A3A2Q2. The ground established through 2A3A2Q1 energizes blower contactor 2K2 through a thermal limit switch that is an integral part of the blower. Energizing 2K2 applies 3-phase, 225-Vac power from CONTROL POWER circuit breaker 2CB2 through 2K2 to the blower in cooling air assembly 2A6. If the blower overheats, the blower thermal limit switch opens the circuit. In the absence of cooling air, air interlock switch 155 opens and the equipment automatically shuts down.

4-151. The blower used in the 208U-3A Amplifier-Power Supply Group contains dual windings that permit operation on either 60- or 400-Hz power. Blower transfer contactor 2A6A2K1 applies input power to the proper winding. A logic 0 or logic 1 output on the blower transfer monitor line indicates the position of 2A6A2K1.

4-152. Blower transfer contactor 2A6A2K1 is operated by blower transfer sensor 2A6A2A1. Primary power is tapped from between 2CB2 and 2K2 and is applied through transformer 2A6A2T1 to 2A6A2A1. An input of 60 Hz will not turn on blower transfer contactor drivers 2A6A2A1Q1 and 2A6A2A1Q2. Blower transfer contactor 2A6A2K1 is not energized and 60-Hz power is applied to the 60-Hz winding blower A6A1B1 when 2K2 is enabled. The blower transfer monitor output is grounded through 2A6A2K1 contacts.

4-153. An input of 400-Hz power to blower transfer sensor 2A6A2A1 turns on blower transfer contactor drivers 2A6A2A1Q1 and 2A6A2A1Q2. Blower transfer contactor 2A6A2K1 is energized by a ground through 2A6A2A1Q2 and 400-Hz power is applied to the 400-Hz winding of blower A6A1B1 when 2K2 is enabled. Ground is removed from the blower transfer monitor output and zener diode 2A6A2CR1 provides a 3.3-Vdc monitor signal.

4-154. FILAMENT SUPPLIES. The filament supply consists of FILAMENT circuit breaker 2CB3, FILAMENT circuit breaker 2CB4, filament contactor driver 2A3A2Q1, filament contactor 2K3, filament transformers 1T1 and 1T2, PA FIL ADJUST potentiometer 2R17, and FILAMENT HOURS meter 2M1.

4-155. Single-phase, 225-Vac, power is applied through FILAMENT circuit breaker 2CB3 and FILAMENT circuit breaker 2CB4 to filament contactor 2K3 (figure 7-4, sheet 1). A logic 1 on the filament control line turns on filament contactor driver 2A3A2Q1 and lights FILAMENT indicator light 1DS1. The ground path established through 2A3A2Q1 energizes filament contactor 2K3 and power is applied to filament transformers 1T1 and 1T2 in the rf amplifier unit. Transformer 1T1 provides 6.8 to 7.5 Vac at 78 A to the filament of power amplifier tube 1V1. Transformer 1T2 provides 6.0 Vac to the filaments of input amplifier tube 1A1V1 and driver amplifier tube 1A1V2. PA FIL ADJUST potentiometer 2R17 provides compensation for power amplifier tube aging. When filament contactor 2K3 is energized, FILAMENT HOURS meter 2M1 also operates to record total operating time of the rf amplifier unit tube filaments.

4-156. HIGH-VOLTAGE SUPPLY. The high-voltage supply consists of high-voltage contactor 2K1, high-voltage contactor drivers 2A3A2Q3 and 2A3A2Q4, the power amplifier plate supply, power amplifier screen supply, and low-level supply.

4-157. A logic 1 on the high-voltage control line turns on high-voltage contactor drivers 2A3A2Q3 and 2A3A2Q4 (figure 7-4, sheet 1), and lights the PLATE indicator light 1DS2. The ground path established through 2A3A2Q3 energizes high-voltage contactor 2K1 (figure 7-4, sheet 3) and 3-phase, 225-Vac power is applied to POWER AMPLIFIER PLATE circuit breaker 2CB7 and LOW LEVEL circuit breaker 2CB5. Power is applied to POWER AMPLIFIER SCREEN circuit breaker 2CB8 through POWER AMPLIFIER PLATE circuit breaker 2CB7.

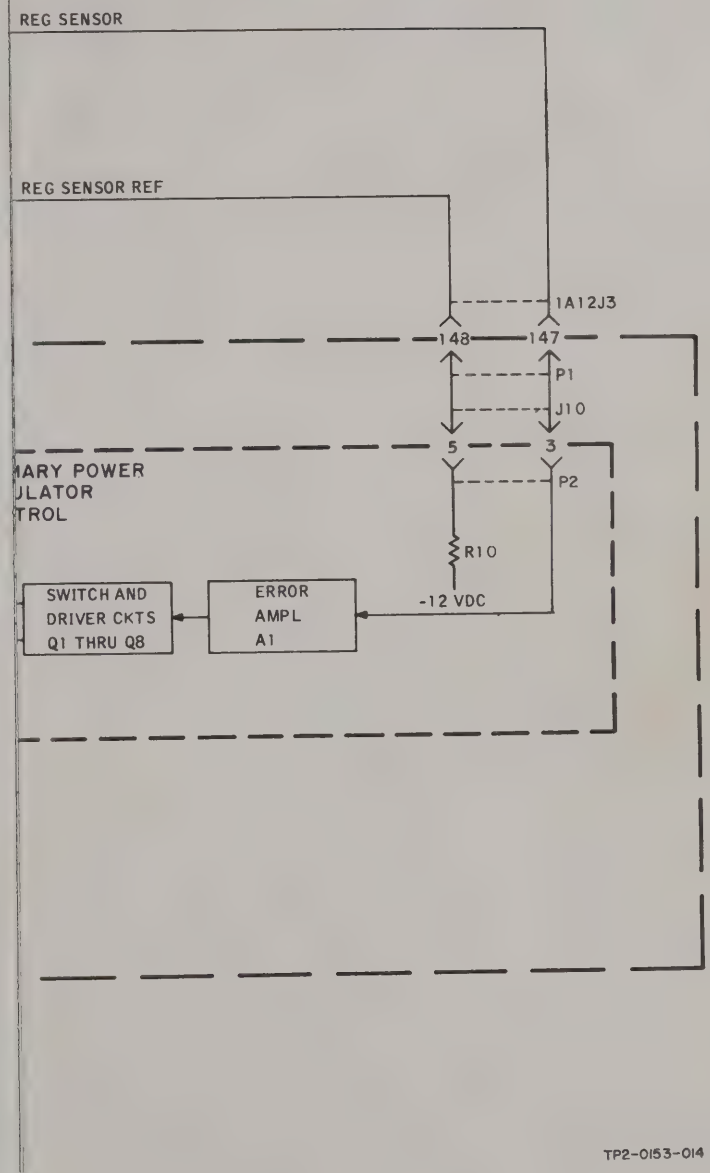

Figure 4-13. Input Voltage Regulation, Simplified Schematic Diagram

drive voltage path to servo motor 2A5B1. T-section filters 2FL8 and 2FL9 limit rf radiation on the drive voltage line.

4-145. +28-VOLT DC SUPPLY. The +28-Vdc supply consists of CONTROL POWER circuit breaker 2CB2, +28-Vdc supply transformer 2T4, +28-Vdc supply 2A1, and filters 2FL4 through 2FL7 (figure 7-4, sheet 2).

4-146. Three-phase 225-Vac power is applied through CONTROL POWER circuit breaker 2CB2 to the delta-connected primary of +28-Vdc supply transformer 2T4. Circuit breaker 2CB2 protects transformer 2T4 and rectifier 2A1CR1 against fault or overload. Transformer 2T4 is a voltage stepdown power transformer. The output of the Y-connected secondary winding of 2T4 is applied to 3-phase full-wave bridge rectifier 2A1CR1. No filtering of the +28-Vdc output developed across 2A1CR1 is necessary. The +28-Vdc output is applied to contactors in the power supply, unit 2, and to servos and relays in rf amplifier, unit 1.

4-147. A +20-Vdc output is derived from a filter consisting of resistors 2A1R1, 2A1R2, and 2A1R3 and capacitors 2A1C1, 2A1C2, and 2A1C3. The +20-Vdc output is regulated by zener regulator 1A1CR6 in the rf amplifier, unit 1, and is applied to the collector of feedback mixer amplifier 1A1Q1.

4-148. Resistors 2A1R4, 2A1R5, and 2A1R6 and capacitor 2A1C4 provide a metering sample output. The 225 Vac from CONTROL POWER circuit breaker 2CB2 is also applied to transformer 1T3 that provides power to the 652J-13 Power Supply 1A7.

4-149. COOLING AIR SUPPLY. The cooling air supply consists of blower contactor driver 2A3A2Q2, blower contactor 2K2, and cooling air assembly 2A6 (figure 7-4, sheets 1 and 2).

4-150. A logic 1 on the blower control input turns on blower contactor driver 2A3A2Q2. The ground established through 2A3A2Q1 energizes blower contactor 2K2 through a thermal limit switch that is an integral part of the blower. Energizing 2K2 applies 3-phase, 225-Vac power from CONTROL POWER circuit breaker 2CB2 through 2K2 to the blower in cooling air assembly 2A6. If the blower overheats, the blower thermal limit switch opens the circuit. In the absence of cooling air, air interlock switch 155 opens and the equipment automatically shuts down.

4-151. The blower used in the 208U-3A Amplifier-Power Supply Group contains dual windings that permit operation on either 60- or 400-Hz power. Blower transfer contactor 2A6A2K1 applies input power to the proper winding. A logic 0 or logic 1 output on the blower transfer monitor line indicates the position of 2A6A2K1.

4-152. Blower transfer contactor 2A6A2K1 is operated by blower transfer sensor 2A6A2A1. Primary power is tapped from between 2CB2 and 2K2 and is applied through transformer 2A6A2T1 to 2A6A2A1. An input of 60 Hz will not turn on blower transfer contactor drivers 2A6A2A1Q1 and 2A6A2A1Q2. Blower transfer contactor 2A6A2K1 is not energized and 60-Hz power is applied to the 60-Hz winding blower A6A1B1 when 2K2 is enabled. The blower transfer monitor output is grounded through 2A6A2K1 contacts.

4-153. An input of 400-Hz power to blower transfer sensor 2A6A2A1 turns on blower transfer contactor drivers 2A6A2A1Q1 and 2A6A2A1Q2. Blower transfer contactor 2A6A2K1 is energized by a ground through 2A6A2A1Q2 and 400-Hz power is applied to the 400-Hz winding of blower A6A1B1 when 2K2 is enabled. Ground is removed from the blower transfer monitor output and zener diode 2A6A2CR1 provides a 3.3-Vdc monitor signal.

4-154. FILAMENT SUPPLIES. The filament supply consists of FILAMENT circuit breaker 2CB3, FILAMENT circuit breaker 2CB4, filament contactor driver 2A3A2Q1, filament contactor 2K3, filament transformers 1T1 and 1T2, PA FIL ADJUST potentiometer 2R17, and FILAMENT HOURS meter 2M1.

4-155. Single-phase, 225-Vac, power is applied through FILAMENT circuit breaker 2CB3 and FILAMENT circuit breaker 2CB4 to filament contactor 2K3 (figure 7-4, sheet 1). A logic 1 on the filament control line turns on filament contactor driver 2A3A2Q1 and lights FILAMENT indicator light 1DS1. The ground path established through 2A3A2Q1 energizes filament contactor 2K3 and power is applied to filament transformers 1T1 and 1T2 in the rf amplifier unit. Transformer 1T1 provides 6.8 to 7.5 Vac at 78 A to the filament of power amplifier tube 1V1. Transformer 1T2 provides 6.0 Vac to the filaments of input amplifier tube 1A1V1 and driver amplifier tube 1A1V2. PA FIL ADJUST potentiometer 2R17 provides compensation for power amplifier tube aging. When filament contactor 2K3 is energized, FILAMENT HOURS meter 2M1 also operates to record total operating time of the rf amplifier unit tube filaments.

4-156. HIGH-VOLTAGE SUPPLY. The high-voltage supply consists of high-voltage contactor 2K1, high-voltage contactor drivers 2A3A2Q3 and 2A3A2Q4, the power amplifier plate supply, power amplifier screen supply, and low-level supply.

4-157. A logic 1 on the high-voltage control line turns on high-voltage contactor drivers 2A3A2Q3 and 2A3A2Q4 (figure 7-4, sheet 1), and lights the PLATE indicator light 1DS2. The ground path established through 2A3A2Q3 energizes high-voltage contactor 2K1 (figure 7-4, sheet 3) and 3-phase, 225-Vac power is applied to POWER AMPLIFIER PLATE circuit breaker 2CB7 and LOW LEVEL circuit breaker 2CB5. Power is applied to POWER AMPLIFIER SCREEN circuit breaker 2CB8 through POWER AMPLIFIER PLATE circuit breaker 2CB7.

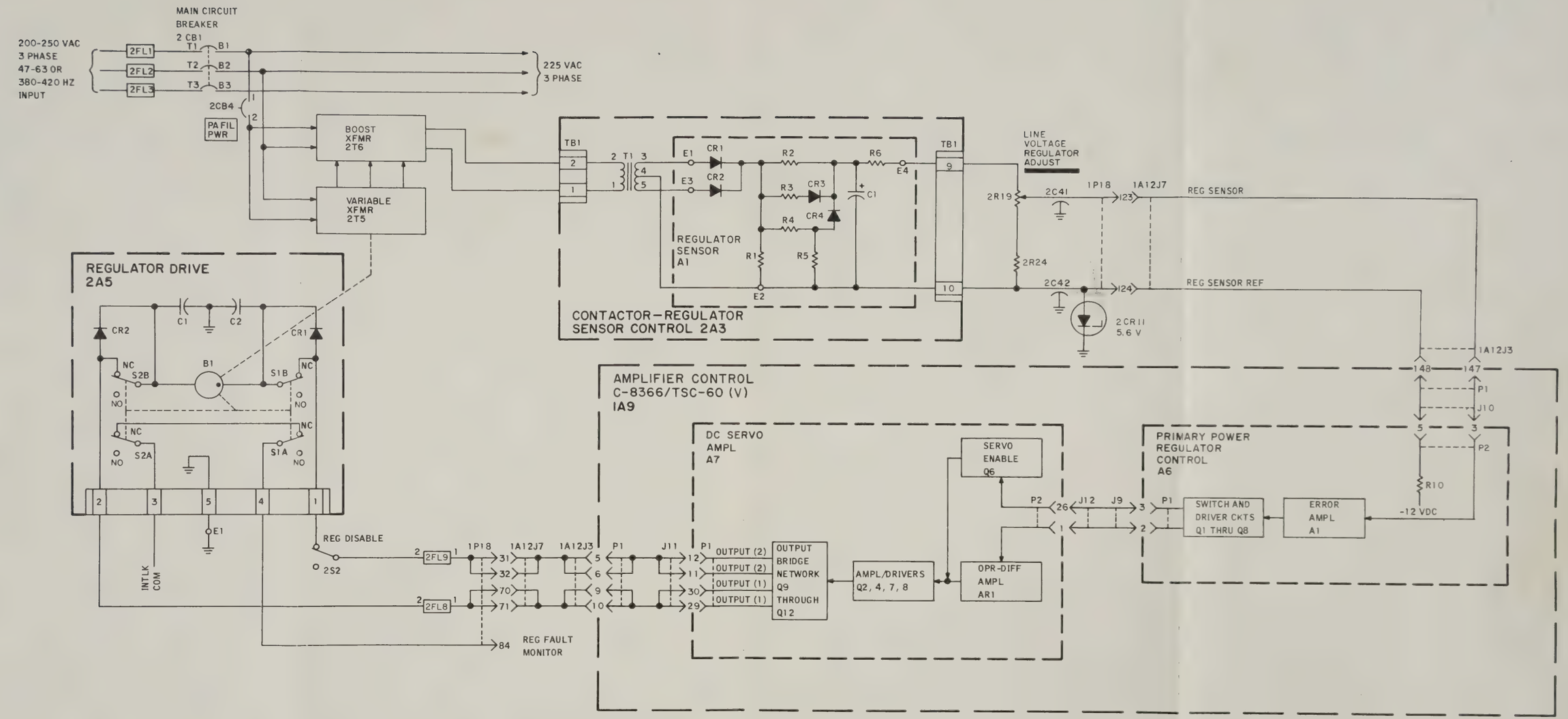

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Figure 4-13. Input Voltage Regulation, Simplified Schematic Diagram

4-158. POWER AMPLIFIER PLATE SUPPLY. Plate transformer 2T1 (figure 7-4, sheet 3) is a 3-phase voltage step-up power transformer. The primary terminals are connected for delta operation. The plate transformer and rectifiers are protected by POWER AMPLIFIER PLATE circuit breaker 2CB7 and overload protection control logic.

4-159. The 3-phase output of the high-voltage secondary of plate transformer 2T1 is rectified by a 3-phase full-wave bridge circuit, 2CR2. The dc voltage developed across the diodes is applied to the plate voltage filter circuit. The filter circuit consists of reactor 2L2 and filter capacitors 2C1 and 2C2. Resistor 2R3 and capacitor 2C3 comprise a plate voltage transient suppressor. Resistor 2R5 limits the charge and discharge currents of filter capacitors 2C1 and 2C2. Resistor 2R4 is a bleeder resistor that discharges 2C1 and 2C2 after power is removed. The +3100-Vdc output is applied to the plate of power amplifier tube 1V1. Resistors 2R13 and capacitor 2C4 provide a plate voltage sample for metering. Resistor 2R6 and zener diode 2CR4 provide a plate current sample for ADL circuits.

4-160. PA PLATE CUR OVLD potentiometer 1A21R12, located on adjustment panel assembly 1A21, provides a threshold voltage for comparison with the plate current sample. Comparison is accomplished by power amplifier plate current overload sensor 1A9A5A2. When the plate current sample voltage exceeds the threshold set by 1A21R12, a power amplifier plate current fault (logic 1 output) signal is developed.

4-161. POWER AMPLIFIER SCREEN SUPPLY. Screen supply transformer 2T2 is a 3-phase voltage step-up power transformer. The primary terminals are connected for delta operation. The screen transformer and rectifier circuits are protected by POWER AMPLIFIER SCREEN circuit breaker 2CB8 and overload protection control logic.

4-162. The 3-phase output of the high-voltage secondary of screen transformer 2T2 is rectified by a 3-phase full-wave bridge circuit, 2A2CR1. The dc voltage developed across the diodes is applied to the screen voltage filter circuit. The screen filter circuit consists of reactors 2A2L1 and 2A2L2, resistor 2A2R3, and capacitors 2A2C2 and 2A2C3. Resistors 2A2R1 and 2A2R2, thyractor 2A2CR2, and capacitor 2A2C1 are a screen voltage transient suppressor. Resistors 2A2R4 and 2A2R5 divide the voltage applied to 2A2C2 and 2A2C3 and also act as bleeder resistors to discharge the filter capacitors. The -790-Vdc output is applied to the cathode of power amplifier tube 1V1 and to the power amplifier bias supply. The -790-Vdc supply is referred to as the screen voltage supply because the negative developed with respect to ground is applied to the power amplifier cathode circuit to maintain the grounded power amplifier screen grid 800 Vdc positive with respect to the cathode. The -790-Vdc output is applied to the power amplifier bias supply to maintain the bias supply negative with respect to the cathode. Resistors 2A2R6 through 2A2R8 and capacitor 2A2C4 provide a sample for power amplifier cathode voltage metering. Resistors 2R15, 2R7, and 2R14 and diodes 2CR5 and 2CR6 provide a power amplifier screen current sample for metering and overload protection.

4-163. PA SCRN CUR OVLD potentiometer 1A21R11, located on adjustment panel assembly 1A21, provides a threshold voltage for comparison with the power amplifier screen current sample. Comparison is accomplished by power amplifier screen current overload sensor 1A9A5A5. When the power amplifier screen current sample voltage exceeds the threshold set by R11, a power amplifier screen current fault signal (logic 1 output) is developed.

4-164. LOW-LEVEL SUPPLY. Low-level supply transformer 2T3 is a 3-phase voltage step-up power transformer. The primary terminals are connected for delta operation. The low-level supply transformer and rectifier circuit are protected by LOW LEVEL circuit breaker 2CB5.

4-165. The 3-phase output of the high-voltage secondary of low-level supply transformer 2T3 is rectified by a 3-phase full-wave bridge circuit, 2CR1. The dc voltage developed across the diodes is applied to the low-level voltage filter circuit. The low-level supply filter circuit consists of filter reactor 2A4L1 and capacitor 2C5. Resistors 2A4A1R3 and 2A4A1R4, capacitor 2A4C1, and thyractor 2A4CR1 are a low-level voltage transient suppressor. The +800-Vdc output is applied to the plates of input amplifier 1A1V1 and driver amplifier 1A1V2. The +250-Vdc output developed across zener diodes 2A4CR2 and 2A4CR3 is applied to the input amplifier and driver screens. The +150-Vdc output developed across 2A4CR3 provides an ALC delay voltage. Resistors 2A4A1R5 through 2A4A1R7 and capacitor 2A4A1C1 provide a plate voltage metering sample. Resistors 2A4A1R8 and 2A4A1R9 and capacitor 2A4A1C2 provide a screen voltage metering sample.

4-166. BIAS-KEY SUPPLY. Bias supply transformer 2A7T1 (figure 7-4, sheet 2) is a single-phase power transformer with two secondary windings. Power amplifier grid bias voltage is provided by one winding. Driver grid bias voltage and IGC voltage are provided by the other winding. The transformer and rectifiers are protected by BIAS KEY circuit breaker 2CB6.

4-167. The output of the power amplifier grid bias secondary winding of 2A7T1 is rectified by a full-wave bridge circuit, 2A7A1CR1. Capacitor 2A7A1C1 and 2A7A1C2 and resistor 2A7A1R1 filter the dc output. The power amplifier grid bias is maintained negative with respect to the power amplifier cathode by applying the -800-Vdc power amplifier cathode

voltage to the positive side of the power amplifier bias supply. A -300-Vdc potential is developed across resistor 2A7A1R1 with respect to the -800-Vdc power amplifier cathode voltage. The power amplifier grid keying circuit consists of resistors 2A7A1R2 through 2A7A1R5 and PA BIAS ADJUST potentiometer 2R16 arranged as a voltage divider, and key relay 2A7K1 contacts 5 and 6. The power amplifier bias voltage is developed between the positive side of the bias supply output and the PA BIAS ADJUST 2R16 slider. In the unkeyed state, key relay 2A7K1 contacts 5 and 6 are open and the voltage divider is removed from the circuit. The total -1100 Vdc (-300 Vdc with respect to the power amplifier cathode) is applied to the power amplifier grid as cutoff bias. In the keyed state, key relay 2A7K1 contacts 5 and 6 are closed and the voltage divider is connected across the output of the power amplifier bias supply. The slider of PA BIAS ADJUST potentiometer 2R16 provides the power amplifier grid with -900 Vdc (-100 Vdc with respect to the power amplifier cathode) operating bias. Resistors 2A7A1R7 through 2A7A1R9 and capacitor 2A7A1C3 provide a sample of power amplifier grid-to-ground voltage for metering.

4-168. The output of the driver grid bias and IGC voltage secondary winding of 2A7T1 is rectified by a full-wave bridge circuit consisting of 2A7A2CR1 through 2A7A2CR4. Reactor 2A7L1 and capacitor 2A7C1 filter the dc potential developed across resistor 2A7A2R2. A -39-Vdc output to the internal gain control is developed across zener regulator 2A7CR2. The driver grid keying circuit consists of resistors 2A7A2R1 and 2A7A2R4, zener regulator 2A7A2CR5, DRIVER BIAS ADJUST potentiometer 2R18, and key relay 2A7K1 contacts 8 and 7. The driver bias voltage is developed between the positive side of the bias supply output and the DRIVER BIAS ADJUST potentiometer 2R18 slider. In the unkeyed state, key relay 2A7K1 contacts 8 and 7 are open, the current path to ground for zener regulator 2A7A2CR5 is open, and the voltage divider formed by resistors 2R18 and 2A7A2R24 is ungrounded. The total driver bias supply voltage of approximately -68 Vdc is applied from the slider of 2R18 to the grid of driver amplifier tube 1A1V2 as cut-off bias. In the keyed state, key relay 2A7K1 contacts 8 and 7 are closed and zener regulator 2A7A2CR5 provides -13 Vdc to the grounded voltage divider. The slider of 2R18 then provides an operating bias of -3.0 to -13 Vdc to the driver amplifier grid.

4-169. Key relay 2A7K1 is operated by key relay driver transistor 2A7A2Q1. A logic 1 on the delayed key enable interlock line turns on 2A7A2Q1. When 2A7A2Q1 is turned on, a ground is provided for key relay 2A7K1 and bias voltage outputs are at keyed levels.

4-170. INTERLOCKS.

4-171. Interlocks in the 208U-3A Amplifier-Power Supply Group provide protection for personnel and equipment. These interlocks are access/plug interlock, circuit breaker interlock, air interlock, and antenna interlock. The following paragraphs describe the operation of these interlocks.

4-172. ACCESS/PLUG INTERLOCK. (Refer to figure 4-14.) The access/plug interlock circuit generates a fault signal if continuity is not maintained through access doors and plug-in assemblies. A single path to ground is interlocked through the power supply unit 2 door, grid compartment door, plate compartment door, low-level driver-amplifier assembly 1A1 cover plate, connectors of all rf amplifier unit 1 plug-in assemblies, and three of the cold compartment plug-in units. If continuity to ground is interrupted, the access/plug interlock fault signal immediately disables the equipment, including the high voltages. In addition, the power supply, grid compartment, and plate compartment door interlocks include shorting switches that short out high-voltage circuits when the doors are not closed.

4-173. CIRCUIT BREAKER INTERLOCK. (Refer to figure 4-15.) The circuit breaker interlock circuit generates a fault signal if continuity is not maintained through all circuit breakers in power supply, unit 2. A single path to ground is interlocked through switch contacts on each circuit breaker. If any circuit breaker is not in its normal closed operation position, a fault indication is generated that must be cleared to restore operation.

4-174. AIR INTERLOCK. Air/temperature interlock switch 1S5 (figure 7-3, sheet 1) provides a ground on the air/temperature interlock line when the blower is operating properly. This interlock requires a supply of cooling air before the filament and high-voltage circuits are energized.

4-175. ANTENNA INTERLOCK. (Refer to figure 7-3, sheet 4.) The antenna interlock circuit prevents the 208U-3A Amplifier-Power Supply Group from being keyed if the rf output circuit is not connected to a proper load such as an antenna, antenna coupler, or other optional system equipment which provides a dc return. 1J2-U and 1J2-S are jumpered if no auxiliary interlocks are required. If an ungrounded antenna is used, 1J2-U must be returned to the auxiliary return at 1J2-T. Auxiliary interlocks are connected between 1J2-U and 1J2-S.

4-176. INDICATORS. (Refer to figure 7-3, sheet 4.) The following four indicator lamps located across the top front edge of the 208U-3A Amplifier-Power Supply Group framework provide visible indication of the operational status of the equipment.

4-177. CONTROL LAMP. The amber CONTROL lamp, 1DS4, indicates that +28-Vdc control power is available. This lamp is in series with the +28-Vdc control power circuit and remains on as long as this control voltage is applied to the equipment.

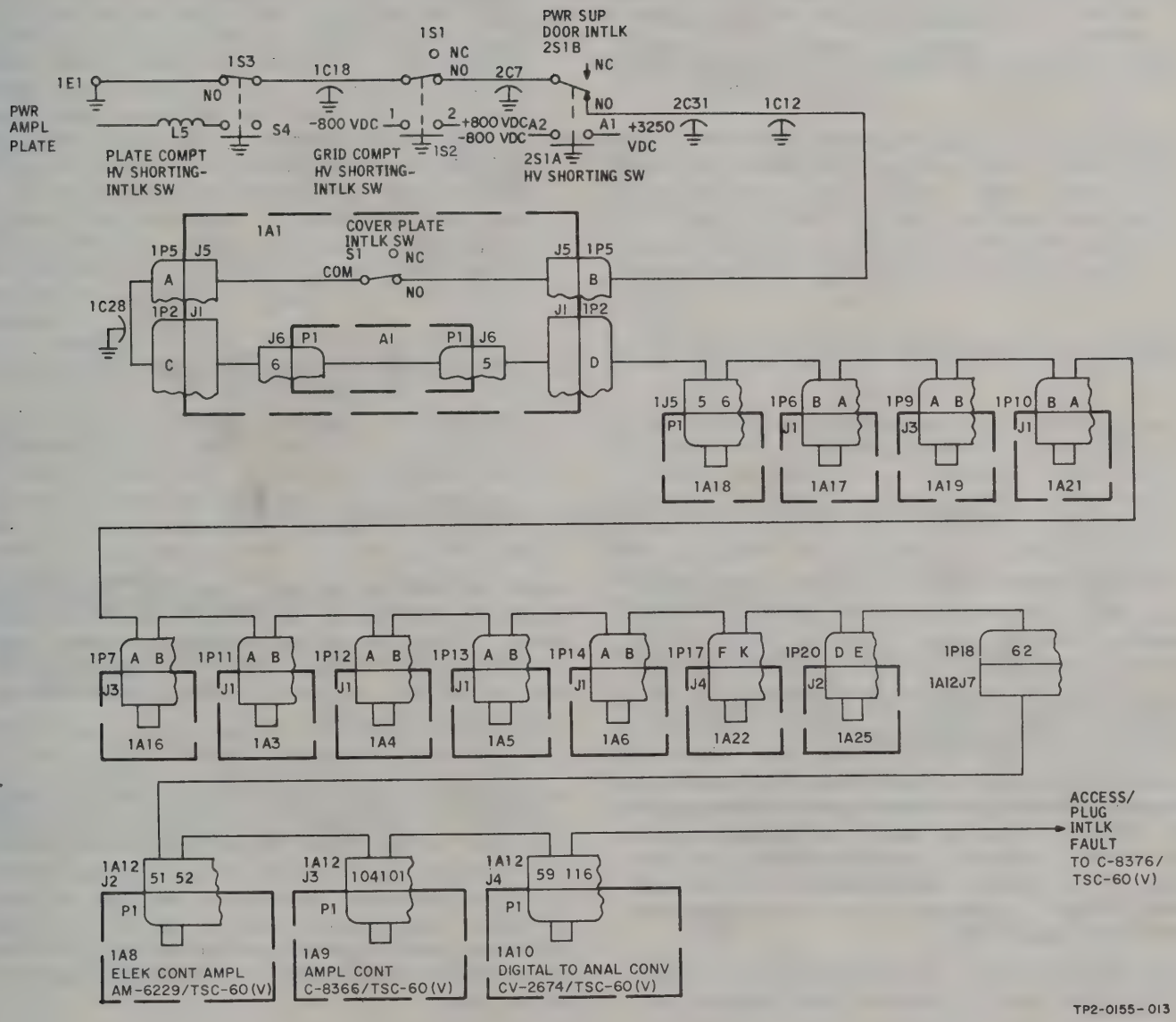


Figure 4-14. Access/Plug Interlock, Simplified Schematic Diagram

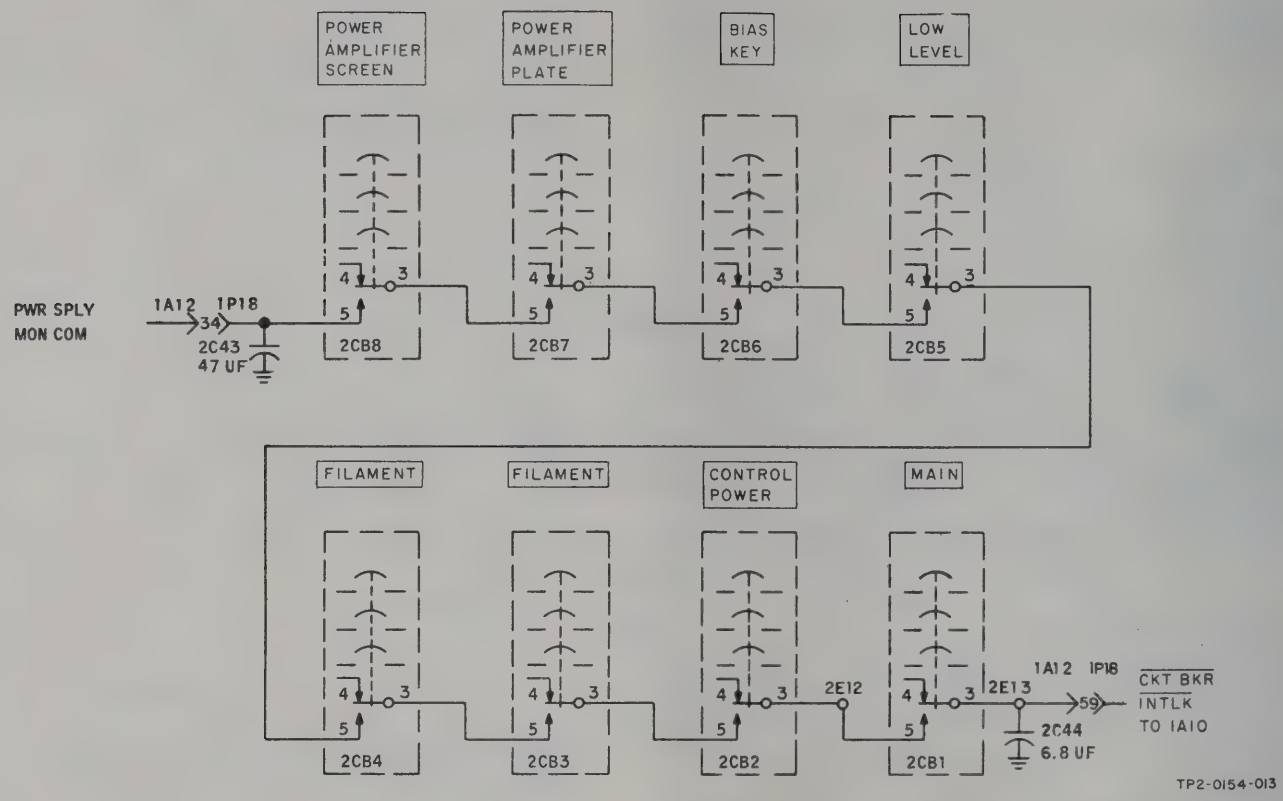


Figure 4-15. Circuit Breaker Interlock, Simplified Schematic Diagram

4-178. FILAMENT LAMP. The green FILAMENT lamp, 1DS1, indicates that the filament control has requested filament power. When a logic 1 on the filament control line is applied to the filament contactor driver, it is applied simultaneously to filament light driver 1A23Q1. A ground is then provided through 1A23Q1 that lights 1DS1.

4-179. PLATE LAMP. The red PLATE lamp, 1DS2, indicates that the high-voltage control has requested high voltage. When a logic 1 on the high-voltage control line is applied to the high-voltage contactor driver, it is applied simultaneously to plate light driver 1A23Q2. A ground is then provided through 1A23Q2 that lights 1DS2.

4-180. READY LAMP. The blue READY lamp, 1DS3, indicates that tuning is complete and the power amplifier is ready to operate. The ready light driver transistor, 1A23Q4, is operated by +28-Vdc control power. When the control voltage is present, it is dropped across resistor 1A23R3 and applied to the base of 1A23Q4. A ground is then provided through 1A23Q4 that lights 1DS3.

4-181. READY lamp operation is inhibited if high voltage is not available or if the power amplifier is not tuned. A logic zero on the high-voltage control line grounds the base of 1A23Q4 through diode 1A23CR1, preventing operation of the light. A logic 1 on the tune complete line or the tune fault line will cause ready light inhibitor transistor 1A23Q3 to ground the base of 1A23Q4, also preventing operation of the lamp.

SECTION III
FUNCTIONAL OPERATION OF MECHANICAL ASSEMBLIES

4-182. GENERAL.

4-183. This section contains functional descriptions of the mechanical drives used for tuning and voltage regulation. The mechanical drives for tuning are driver tuning drive assembly 1A3, plate primary tuning drive assembly 1A4, secondary capacitor tuning drive assembly 1A5, and loading coil tuning drive assembly 1A6. The mechanical drive for voltage regulation is regulator drive unit 2A5. Refer to section II of this chapter for a detailed description of the electronic circuits controlling these drive assemblies. All servo motors discussed in this section are energized by, and direction of rotation is determined by, signals from these control circuits.

4-184. DRIVER TUNING DRIVE ASSEMBLY 1A3.

4-185. Driver tuning drive assembly 1A3 tunes the driver amplifier plate circuit consisting of 1A2L1 and 1A2C1. (This circuit is located in driver power amplifier interstage network 1A2.) When servo motor 1A3B1 is energized, the gear and drive assembly in 1A3 positions 1A2L1 and 1A2C1. The gear and drive assembly also positions the slider of servo followup potentiometer 1A3R1.

4-186. PLATE PRIMARY TUNING DRIVE ASSEMBLY 1A4.

4-187. Plate primary tuning drive assembly 1A4 tunes the power amplifier plate circuit consisting of 1A13L1, 1A13L2, and 1A13C13. (This circuit is located in primary tune coil assembly 1A13.) When servo motor 1A4B1 is energized, the gear and drive assembly in 1A4 positions 1A13L1, 1A13L2, and 1A13C13. The gear and drive assembly also positions the slider of servo followup potentiometer 1A4R1 and energizes primary tuning tachometer 1A4B2.

4-188. SECONDARY CAPACITOR TUNING DRIVE ASSEMBLY 1A5.

4-189. Secondary capacitor tuning drive assembly 1A5 tunes secondary capacitor C14 located in the power amplifier plate circuit. When servo motor 1A5B1 is energized, the gear and drive assembly in 1A4 positions C14. The gear and drive assembly also positions the slider of servo followup potentiometer 1A5R1.

4-190. LOADING COIL TUNING DRIVE ASSEMBLY 1A6.

4-191. Loading coil tuning drive assembly 1A6 tunes the power amplifier loading coil 1A14L1. (This coil is located in loading coil assembly 1A14.) When servo motor 1A6B1 is energized, the gear and drive assembly in 1A6 positions 1A14L1. The gear and drive assembly also positions the slider of servo followup potentiometer 1A6R1 and energizes loading tachometer 1A6B2.

4-192. REGULATOR DRIVE UNIT 2A5.

4-193. Regulator drive unit 2A5 tunes variable transformer 2T5 in the filament voltage regulation circuit. When servo motor 2A5B1 is energized, the gear and drive assembly in 2A5 positions 2T5. The gear and drive assembly also controls switches 2A5S1 and 2A5S2 to automatically limit revolutions.

CHAPTER 5
MAINTENANCE

5-1. INTRODUCTION.

5-2. Within the maintenance concept established for the AN/TSC-60(V) series, maintenance testing is accomplished using the related communication central as a test-bed to fault-isolate to a slice (module) or card. For organizational/field maintenance procedures, refer to TO 31S1-2TSC60-2, Technical Manual Service, Communication Central AN/TSC-60(V)1.

5-3. Depot level maintenance for AN/TSC-60(V) equipment is contained in TO 31S1-2TSC60-173, Technical Manual Service, Communication Centrals AN/TSC-60(V)1/2/3/4.

CHAPTER 7
CIRCUIT DIAGRAMS

7-1. GENERAL.

7-2. This chapter contains pin functions and connector identification, waveforms, voltage measurements, and circuit diagrams. The purpose of these diagrams is to assist the technician in understanding component makeup and circuit arrangement in the equipment. The diagrams also furnish the technician with visual assistance for tracing continuity and trouble analysis, and serve as a reference during maintenance work on the equipment. General information pertaining to individual diagrams is included in the form of notes on the diagram.

7-3. BACKPLANE INTERCONNECT DIAGRAMS.

7-4. The purpose of these diagrams is to show the electrical interface between the units that plug into the backplane. The reference designators of all backplane connectors and the unit connectors that they mate with are listed across the top of the diagram. All functions are listed vertically on the left side of the diagram.

7-5. To use these diagrams, go to the desired function and follow it horizontally to determine to which units the function is interconnected.

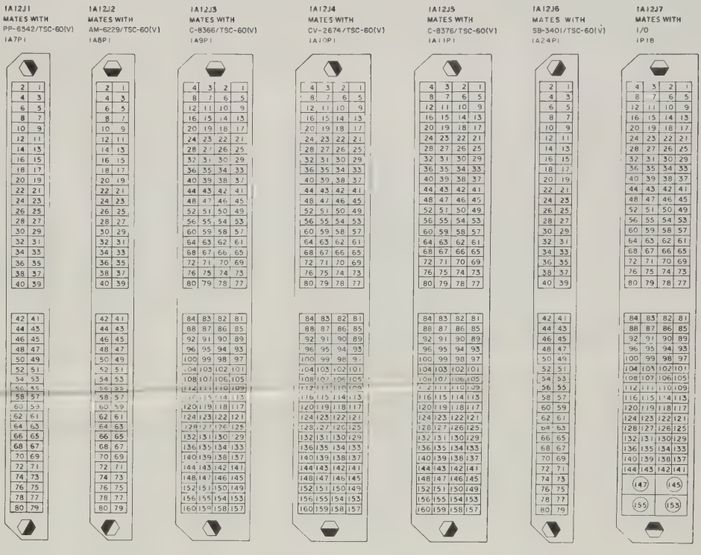
40	SERVO MOTOR, DRIVER TUNING (-)	80	+12 VDC POWER

P/O CONNECTOR
1A12J3

PIN	FUNCTION	PIN	FUNCTION
1	DEMAND SURVEILLANCE (NOT USED)	41	VSWR OVERLOAD SENSOR SAMPLE
2	NOT USED	42	VSWR OVERLOAD THRESHOLD
3	NOT USED	43	20 VDC FLOATING (+)
4	NOT USED	44	NOT USED
5	SERVO MOTOR, REGULATOR (2)	45	SERVO RUN SENSOR, LOADING
6	SERVO MOTOR, REGULATOR (2)	46	VSWR OVERLOAD SENSOR
7	NOT USED	47	$\overline{\text{SERVO ERROR REQUEST}}$, LOADING
8	NOT USED	48	NOT USED
9	SERVO MOTOR, REGULATOR (1)	49	INPUT AMPL BIAS CONTROL (HV SIDE)
10	SERVO MOTOR, REGULATOR (1)	50	NOT USED
11	NOT USED	51	PA SCREEN CURRENT OVERLOAD THRESHOLD
12	NOT USED	52	SERVO FOLLOW-UP LOW
13	NOT USED	53	-39 VDC IGC SUPPLY
14	+30 VDC FLOATING	54	INPUT AMPL BIAS CONTROL (LV SIDE)
15	NOT USED	55	$\overline{\text{SERVO ERROR REQUEST}}$, DRIVER TUNING
16	NOT USED	56	NOT USED
17	NOT USED	57	PHASE DISCRIMINATOR, SECONDARY TUNING
18	NOT USED	58	SERVO FOLLOW-UP POT, SECONDARY TUNING (SLIDER)
19	NOT USED	59	SERVO RUN SENSOR, DRIVER TUNING
20	NOT USED	60	0 VDC FLOATING
21	$\overline{\text{SERVO ERROR REQUEST}}$, PRIMARY	61	NOT USED
22		62	SERVO MODE CONTROL, SECONDARY TUNING
23	PA PLATE CURRENT OVERLOAD THRESHOLD	63	NOT USED
24	NOT USED	64	NOT USED
25	SERVO RUN SENSOR, PRIMARY TUNING	65	SERVO MODE CONTROL, PRIMARY TUNING
26	REGULATOR INPUT SENSOR SAMPLE	66	PHASE DISCRIMINATOR, PRIMARY TUNING
27	PA PLATE CURRENT OVERLOAD	67	SERVO FOLLOW-UP POT, PRIMARY TUNING (SLIDER)
28	NOT USED	68	ANALOG NO. 9, SERVO POSITION, PRIMARY TUNING
29	SERVO RUN SENSOR, SECONDARY TUNING	69	SERVO PREAMPL, PRIMARY TUNING
30	SERVO ERROR REQUEST, SECONDARY	70	TACHOMETER, PRIMARY TUNING (1)
31	TUNE POWER CONTROL (COLLECTOR)	71	TACHOMETER, PRIMARY TUNING (2)
32	NOT USED	72	NOT USED
33	SERVO ERROR BIT 1	73	-12 VDC POWER
34	20 VDC FLOATING (-)	74	-12 VDC POWER
35	TUNE POWER CONTROL	75	+12 VDC POWER
36	NOT USED	76	+12 VDC POWER
37	NOT USED	77	+28 VDC SERVO AND RELAY POWER
38	$\overline{\text{REGULATOR INPUT SENSOR}}$	78	+28 VDC SERVO AND RELAY POWER
39	SERVO ERROR BIT 2	79	+5 VDC POWER
40	NOT USED	80	+5 VDC POWER

TP2-0146-035

Figure 7-1. Backplane Assembly 1A12, Pin Function and Connector Identification Diagram (Sheet 1 of 3)



NOTE

CONNECTORS A12J1 THRU A12J7 ARE SHOWN IN SEQUENCE AS THEY APPEAR ON THE BACKPLANE AND AS VIEWED FROM THEIR MATING CONNECTORS

CONNECTOR
1A12J1

PIN	FUNCTION
1	CHASSIS GROUND
2	CHASSIS GROUND
3	CHASSIS GROUND
4	CHASSIS GROUND
5	NOT USED
6	NOT USED
7	NOT USED
8	NOT USED
9	NOT USED
10	NOT USED
11	NOT USED
12	NOT USED
13	NOT USED
14	NOT USED
15	NOT USED
16	NOT USED
17	NOT USED
18	NOT USED
19	NOT USED
20	NOT USED
21	NOT USED
22	NOT USED
23	NOT USED
24	NOT USED
25	NOT USED
26	NOT USED
27	NOT USED
28	NOT USED
29	GROUND
31	
32	+5 VDC POWER
33	+5 VDC POWER
34	NOT USED
35	+5 VDC POWER
36	+5 VDC POWER
37	GROUND
38	GROUND
39	+20 VDC POWER (NOT USED)
40	+20 VDC POWER RETURN (NOT USED)
41	+12 VDC POWER
42	+12 VDC POWER
43	GROUND
44	-12 VDC POWER
45	GROUND
46	GROUND
47	NOT USED
48	NOT USED
49	NOT USED
50	NOT USED
51	NOT USED
52	NOT USED
53	NOT USED
54	NOT USED
55	NOT USED
56	NOT USED
57	NOT USED
58	NOT USED
59	NOT USED
60	NOT USED
61	NOT USED
62	NOT USED
63	NOT USED
64	NOT USED
65	+28 VDC CCCS POWER
66	+28 VDC CCCS POWER
67	+28 VDC CCCS POWER
68	+28 VDC CCCS POWER
69	NOT USED
70	NOT USED
71	+28 VDC CCCS POWER COMMON
72	+28 VDC CCCS POWER COMMON
73	+28 VDC CCCS POWER COMMON
74	+28 VDC CCCS POWER COMMON
75	NOT USED
76	NOT USED
77	CHASSIS GROUND
78	CHASSIS GROUND
79	CHASSIS GROUND
80	CHASSIS GROUND

CONNECTOR
1A12J2

PIN	FUNCTION
1	+28 VDC SERVO AND RELAY COMMON
2	+28 VDC SERVO AND RELAY COMMON
3	SERVO MOTOR, LOADING (2)
4	SERVO MOTOR, LOADING (2)
5	NOT USED
6	NOT USED
7	SERVO MOTOR, LOADING (1)
8	SERVO MOTOR, LOADING (1)
9	+28 VDC SERVO RELAY POWER
10	+28 VDC SERVO RELAY POWER
11	NOT USED
12	NOT USED
13	+28 VDC SERVO AND RELAY COMMON
14	+28 VDC SERVO AND RELAY COMMON
15	SERVO MOTOR, SECONDARY TUNING (2)
16	SERVO MOTOR, SECONDARY TUNING (2)
17	NOT USED
18	NOT USED
19	SERVO MOTOR, SECONDARY TUNING (1)
20	SERVO MOTOR, SECONDARY TUNING (1)
21	+28 VDC SERVO RELAY POWER
22	+28 VDC SERVO RELAY POWER
23	NOT USED
24	NOT USED
25	+28 VDC SERVO AND RELAY COMMON
26	+28 VDC SERVO AND RELAY COMMON
27	SERVO MOTOR, PRIMARY TUNING (2)
28	SERVO MOTOR, PRIMARY TUNING (2)
29	NOT USED
30	NOT USED
31	SERVO MOTOR, PRIMARY TUNING (1)
32	SERVO MOTOR, PRIMARY TUNING (1)
33	+28 VDC SERVO RELAY POWER
34	+28 VDC SERVO RELAY POWER
35	NOT USED
36	NOT USED
37	+28 VDC SERVO AND RELAY COMMON
38	+28 VDC SERVO AND RELAY COMMON
39	SERVO MOTOR, DRIVER TUNING (-)
40	SERVO MOTOR, DRIVER TUNING (-)
41	SERVO MOTOR, DRIVER TUNING (+)
42	SERVO MOTOR, DRIVER TUNING (+)
43	+28 VDC SERVO RELAY POWER
44	+28 VDC SERVO RELAY POWER
45	SHELL COMMON
46	SHELL COMMON
47	GROUND
48	GROUND
49	GROUND
50	GROUND
51	ACCESS PLUG INTERLOCK
52	ACCESS PLUG INTERLOCK
53	SERVO PREAMPL, DRIVER TUNING
54	SERVO GROUND
55	NOT USED
56	NOT USED
57	+12 VDC POWER
58	SERVO ENABLE, DRIVER TUNING
59	SERVO GROUND
60	-12 VDC POWER
61	NOT USED
62	SERVO PREAMPL, SECONDARY TUNING
63	SERVO ENABLE, PRIMARY TUNING
64	NOT USED
65	-12 VDC POWER
66	+12 VDC POWER
67	SERVO PREAMPL, DRIVER TUNING
68	SERVO GROUND
69	NOT USED
70	NOT USED
71	+12 VDC POWER
72	SERVO ENABLE, SECONDARY TUNING
73	SERVO GROUND
74	-12 VDC POWER
75	NOT USED
76	SERVO PREAMPL, LOADING
77	SERVO ENABLE, LOADING
78	NOT USED
79	-12 VDC POWER
80	+12 VDC POWER

P/O CONNECTOR
1A12J3

PIN	FUNCTION
1	DEMAND SURVEILLANCE (NOT USED)
2	NOT USED
3	NOT USED
4	NOT USED
5	SERVO MOTOR, REGULATOR (2)
6	SERVO MOTOR, REGULATOR (2)
7	NOT USED
8	NOT USED
9	SERVO MOTOR, REGULATOR (1)
10	SERVO MOTOR, REGULATOR (1)
11	NOT USED
12	NOT USED
13	NOT USED
14	+30 VDC FLOATING
15	NOT USED
16	NOT USED
17	NOT USED
18	NOT USED
19	NOT USED
20	NOT USED
21	SERVO ERROR REQUEST, PRIMARY
22	
23	PA PLATE CURRENT OVERLOAD THRESHOLD
24	NOT USED
25	SERVO RUN SENSOR, PRIMARY TUNING
26	REGULATOR INPUT SENSOR SAMPLE
27	PA PLATE CURRENT OVERLOAD
28	NOT USED
29	SERVO RUN SENSOR, SECONDARY TUNING
30	SERVO ERROR REQUEST, SECONDARY
31	TUNE POWER CONTROL (COLLECTOR)
32	NOT USED
33	SERVO ERROR BIT 1
34	20 VDC FLOATING (-)
35	TUNE POWER CONTROL
36	NOT USED
37	NOT USED
38	REGULATOR INPUT SENSOR
39	SERVO ERROR BIT 2
40	NOT USED
41	VSWR OVERLOAD SENSOR SAMPLE
42	VSWR OVERLOAD THRESHOLD
43	20 VDC FLOATING (+)
44	NOT USED
45	SERVO RUN SENSOR, LOADING
46	VSWR OVERLOAD SENSOR
47	SERVO ERROR REQUEST, LOADING
48	NOT USED
49	INPUT AMPL BIAS CONTROL (HV SIDE)
50	NOT USED
51	PA SCREEN CURRENT OVERLOAD THRESHOLD
52	SERVO FOLLOW-UP LOW
53	-30 VDC IGC SUPPLY
54	INPUT AMPL BIAS CONTROL (LV SIDE)
55	SERVO ERROR REQUEST, DRIVER TUNING
56	NOT USED
57	PHASE DISCRIMINATOR, SECONDARY TUNING
58	SERVO FOLLOW-UP POT, SECONDARY TUNING (SLIDER)
59	SERVO RUN SENSOR, DRIVER TUNING
60	C VDC FLOATING
61	NOT USED
62	SERVO MODE CONTROL, SECONDARY TUNING
63	NOT USED
64	NOT USED
65	SERVO MODE CONTROL, PRIMARY TUNING
66	PHASE DISCRIMINATOR, PRIMARY TUNING
67	SERVO FOLLOW-UP POT, PRIMARY TUNING (SLIDER)
68	ANALOG NO. 9, SERVO POSITION, PRIMARY TUNING
69	SERVO PREAMPL, PRIMARY TUNING
70	TACHOMETER, PRIMARY TUNING (1)
71	TACHOMETER, PRIMARY TUNING (2)
72	NOT USED
73	-12 VDC POWER
74	-12 VDC POWER
75	+12 VDC POWER
76	+12 VDC POWER
77	+28 VDC SERVO AND RELAY POWER
78	+28 VDC SERVO AND RELAY POWER
79	+5 VDC POWER
80	+5 VDC POWER

Figure 7-1. Backplane Assembly 1A12, Pin Function and Connector Identification Diagram (Sheet 1 of 3)

11	ANALOG ADDRESS NO. 7	51	ANALOG NO. 31, SPARE (10 V FULL SCALE)
12	ANALOG ADDRESS NO. 8	52	ANALOG NO. 32, VM PROBE (10 V FULL SCALE)
13	ANALOG ADDRESS NO. 9	53	RANGE SELECT NO. 1
14	ANALOG ADDRESS NO. 10	54	RANGE SELECT NO. 2
15	ANALOG ADDRESS NO. 11	55	RANGE SELECT NO. 3
16	ANALOG ADDRESS NO. 12	56	RANGE SELECT NO. 4
17	ANALOG ADDRESS NO. 13	57	RANGE SELECT NO. 5
18	ANALOG ADDRESS NO. 14	58	RANGE SELECT NO. 6
19	ANALOG ADDRESS NO. 15	59	RANGE SELECT NO. 7
20	ANALOG ADDRESS NO. 16	60	RANGE SELECT NO. 8
21	ANALOG NO. 1, RF INPUT VM SAMPLE	61	NOT USED
22	ANALOG NO. 2, SPARE (10V FULL SCALE)	62	NOT USED
23	ANALOG NO. 3, DRIVER GRID RF VM SAMPLE	63	NOT USED
24	ANALOG NO. 4, PA GRID RF VM SAMPLE	64	NOT USED
25	ANALOG NO. 5, PA PLATE RF VM SAMPLE	65	NOT USED
26	ANALOG NO. 6, FORWARD POWER SAMPLE	66	NOT USED
27	ANALOG NO. 7, REFLECTED POWER SAMPLE	67	NOT USED
28	ANALOG NO. 8, SERVO POSITION, DRIVER TUNING	68	NOT USED
29	ANALOG NO. 9, SERVO POSITION, PRIMARY TUNING	69	SHELL COMMON
30	ANALOG NO. 10, SERVO POSITION, SECONDARY TUNING	70	SHELL COMMON
31	ANALOG NO. 11, SERVO POSITION, LOADING	71	SHELL COMMON
32	ANALOG NO. 12, PA SCREEN CURRENT SAMPLE	72	SHELL COMMON
33	ANALOG NO. 13, PA PLATE CURRENT SAMPLE	73	+12 VDC POWER
34	ANALOG NO. 14, INPUT AMPLE CATHODE CURRENT SAMPLE	74	+12 VDC POWER
35	ANALOG NO. 15, INPUT AMPLE SCREEN DC VM SAMPLE	75	+5 VDC POWER
36	ANALOG NO. 16, INPUT AMPL PLATE DC VM SAMPLE	76	+5 VDC POWER
37	ANALOG NO. 17, DRIVER CATHODE CURRENT SAMPLE	77	-12 VDC POWER
38	ANALOG NO. 18, DRIVER SCREEN DC VM SAMPLE	78	-12 VDC POWER
39	ANALOG NO. 19, DRIVER PLATE DC VM SAMPLE	79	+5 VDC POWER
40	ANALOG NO. 20, PA GRID VOLTAGE SAMPLE	80	+5 VDC POWER

TP2-0146-036

Figure 7-1. Backplane Assembly 1A12, Pin Function and Connector Identification Diagram (Sheet 2 of 3)

P/O CONNECTOR
1A12J3

PIN	FUNCTION
81	GROUND
82	GROUND
83	GROUND
84	GROUND
85	SERVO MODE CONTROL, DRIVER TUNING
86	NOT USED
87	NOT USED
88	SERVO PREAMPL, SECONDARY TUNING
89	SERVO FOLLOW-UP POT, LOADING (SLIDER)
90	NOT USED
91	NOT USED
92	NOT USED
93	LOADING COMPARATOR
94	ANALOG NO. 10, SERVO POSITION, SECONDARY TUNING
95	NOT USED
96	NOT USED
97	SERVO MODE CONTROL, LOADING
98	SERVO FOLLOW-UP POT, DRIVER TUNING (SLIDER)
99	PHASE DISCRIMINATOR, DRIVER TUNING
100	NOT USED
101	ACCESS PLUG INTERLOCK
102	NOT USED
103	NOT USED
104	ACCESS PLUG INTERLOCK
105	ANALOG NO. 13, PA PLATE CURRENT SAMPLE
106	TACHOMETER, LOADING (1)
107	NOT USED
108	NOT USED
109	NOT USED
110	NOT USED
111	NOT USED
112	NOT USED
113	TACHOMETER, LOADING (2)
114	ANALOG NO. 11, SERVO POSITION, LOADING
115	SERVO PREAMPL, LOADING
116	NOT USED
117	NOT USED
118	ANALOG NO. 8, SERVO POSITION, DRIVER TUNING
119	SERVO PREAMPL, DRIVER TUNING
120	NOT USED
121	DRIVER GRID OVERDRIVE CONTROL (IGC INPUT)
122	TUNE POWER LEVEL SAMPLE
123	SERVO GROUND
124	NOT USED
125	NOT USED
126	PA KEYLINE
127	SERVO GROUND
128	NOT USED
129	ALC CONTROL INPUT (IGC SAMPLE)
130	ANODE DISSIPATION LIMITER (RF SAMPLE)
131	ANODE DISSIPATION LIMITER (PLATE CURRENT THRESHOLD)
132	NOT USED
133	NOT USED
134	NOT USED
135	NOT USED
136	NOT USED
137	BACKPLANE INTERLOCK
138	PA SCREEN CURRENT OVERLOAD
139	SERVO GROUND
140	NOT USED
141	PA SCREEN CURRENT SAMPLE
142	ANALOG NO. 12, PA SCREEN CURRENT SAMPLE
143	SERVO GROUND
144	NOT USED
145	PA PLATE CURRENT SAMPLE
146	ANALOG NO. 24, REGULATED AC-VM SAMPLE
147	REGULATOR SENSOR
148	REGULATOR SENSOR REFERENCE
149	NOT USED
150	NOT USED
151	NOT USED
152	SHELL COMMON
153	NOT USED
154	NOT USED
155	SPARE
156	SHELL COMMON
157	NOT USED
158	NOT USED
159	NOT USED
160	NOT USED

P/O CONNECTOR
1A12J4

PIN	FUNCTION
1	GROUND
2	GROUND
3	GROUND
4	GROUND
5	+30 VDC FLOATING
6	NOT USED
7	SERVO DISABLE, DRIVER TUNING
8	SERVO MODE, DRIVER TUNING
9	SERVO FOLLOW-UP HIGH
10	AUTO/MANUAL
11	SERVO DISABLE, PRIMARY TUNING
12	SERVO MODE, PRIMARY TUNING
13	SERVO GROUND
14	FILAMENT ENABLE
15	SERVO DISABLE, SECONDARY TUNING
16	SERVO MODE, SECONDARY TUNING
17	SERVO FOLLOW-UP LOW
18	HIGH VOLTAGE ENABLE
19	SERVO DISABLE, LOADING
20	SERVO MODE, LOADING
21	0 VDC FLOATING
22	KEY ENABLE
23	NOT USED
24	NOT USED
25	NOT USED
26	EXCITER TUNE/OPERATE
27	NOT USED
28	NOT USED
29	TUNE START
30	NOT USED
31	NOT USED
32	NOT USED
33	NOT USED
34	FILAMENT TIMER
35	NOT USED
36	NOT USED
37	DATA (EIGHT BIT DELAYED)
38	AUX KEY ENABLE
39	DEMAND SURVEILLANCE (NOT USED)
40	PA PLATE CURRENT OVERLOAD
41	NOT USED
42	ERROR MONITOR REQUEST
43	RF INPUT SENSOR
44	PA SCREEN CURRENT OVERLOAD
45	CLOCK
46	SERVO ACTIVATE
47	AIR INTERLOCK
48	NOT USED
49	NOT USED
50	CONTROL A
51	CIRCUIT BREAKER INTLK
52	NOT USED
53	NOT USED
54	CONTROL B
55	RF PROVE
56	VSWR OVERLOAD SENSOR
57	NOT USED
58	CONTROL C
59	ACCESS PLUG INTERLOCK
60	SPARE
61	NOT USED
62	SERVO ENABLE
63	ANTENNA INTERLOCK
64	TGC INHIBIT
65	+28 VDC COMMON
66	+28 VDC COMMON
67	NOT USED
68	NOT USED
69	SHELL COMMON
70	SHELL COMMON
71	SHELL COMMON
72	SHELL COMMON
73	POSITIVE 28 VDC SERVO AND RELAY POWER
74	POSITIVE 28 VDC SERVO AND RELAY POWER
75	-12 VDC POWER
76	-12 VDC POWER
77	+12 VDC POWER
78	+12 VDC POWER
79	+5 VDC POWER
80	+5 VDC POWER
81	NOT USED
82	SERVO ENABLE, DRIVER TUNING
83	SERVO RUN SENSOR, DRIVER TUNING
84	NOT USED
85	TUNE COMPLETE
86	SERVO ENABLE, PRIMARY TUNING
87	SERVO RUN SENSOR, PRIMARY TUNING
88	NOT USED
89	PA OPERATE REQUEST
90	SERVO ENABLE, SECONDARY TUNING
91	SERVO RUN SENSOR, SECONDARY TUNER
92	POWER INTERRUPT
93	PA READY (NOT USED)
94	SERVO ENABLE, LOADING
95	SERVO RUN SENSOR, LOADING
96	TGC INHIBIT
97	NOT USED
98	NOT USED
99	NOT USED
100	REFLECTED POWER FAULT
101	NOT USED
102	NOT USED
103	NOT USED
104	PA SCREEN CURRENT FAULT
105	NOT USED
106	NOT USED
107	NOT USED
108	PA PLATE CURRENT FAULT
109	NOT USED
110	NOT USED
111	NOT USED
112	KEY MONITOR
113	NOT USED
114	SERVO ERROR REQUEST, DRIVER TUNING
115	SERVO MODE CONTROL, DRIVER TUNING
116	ACCESS PLUG INTERLOCK FAULT
117	NOT USED
118	SERVO ERROR REQUEST, PRIMARY TUNING
119	SERVO MODE CONTROL, PRIMARY TUNING
120	CIRCUIT BREAKER FAULT
121	NOT USED
122	SERVO ERROR REQUEST, SECONDARY TUNING
123	SERVO MODE CONTROL, SECONDARY TUNING
124	TUNE SEQUENCE POSITION BIT A
125	TUNE POWER CONTROL
126	SERVO ERROR REQUEST, LOADING
127	SERVO MODE CONTROL, LOADING
128	TUNE SEQUENCE POSITION BIT B
129	ALC/TGC RELAY CONTROL
130	NOT USED
131	NOT USED
132	TUNE SEQUENCE POSITION BIT C
133	PA KEYLINE
134	NOT USED
135	NOT USED
136	NOT USED
137	BLOWER CONTROL
138	NOT USED
139	NOT USED
140	NOT USED
141	BACKPLANE INTERLOCK
142	NOT USED
143	NOT USED
144	NOT USED
145	SPARE
146	NOT USED
147	PA TUNE
148	GROUND
149	FILAMENT CONTROL
150	NOT USED
151	NOT USED
152	20 VDC FLOATING (+)
153	HIGH VOLTAGE CONTROL
154	TUNE RESISTOR CONTROL
155	NOT USED
156	20 VDC FLOATING (-)
157	GROUND
158	GROUND
159	GROUND
160	GROUND

P/O CONNECTOR
1A12J5

PIN	FUNCTION
1	GROUND
2	GROUND
3	GROUND
4	GROUND
5	ANALOG ADDRESS NO. 1
6	ANALOG ADDRESS NO. 2
7	ANALOG ADDRESS NO. 3
8	ANALOG ADDRESS NO. 4
9	ANALOG ADDRESS NO. 5
10	ANALOG ADDRESS NO. 6
11	ANALOG ADDRESS NO. 7
12	ANALOG ADDRESS NO. 8
13	ANALOG ADDRESS NO. 9
14	ANALOG ADDRESS NO. 10
15	ANALOG ADDRESS NO. 11
16	ANALOG ADDRESS NO. 12
17	ANALOG ADDRESS NO. 13
18	ANALOG ADDRESS NO. 14
19	ANALOG ADDRESS NO. 15
20	ANALOG ADDRESS NO. 16
21	ANALOG NO. 1, RF INPUT VM SAMPLE
22	ANALOG NO. 2, SPARE (10V FULL SCALE)
23	ANALOG NO. 3, DRIVER GRID RF VM SAMPLE
24	ANALOG NO. 4, PA GRID RF VM SAMPLE
25	ANALOG NO. 5, PA PLATE RF VM SAMPLE
26	ANALOG NO. 6, FORWARD POWER SAMPLE
27	ANALOG NO. 7, REFLECTED POWER SAMPLE
28	ANALOG NO. 8, SERVO POSITION, DRIVER TUNING
29	ANALOG NO. 9, SERVO POSITION, PRIMARY TUNING
30	ANALOG NO. 10, SERVO POSITION, SECONDARY TUNING
31	ANALOG NO. 11, SERVO POSITION, LOADING
32	ANALOG NO. 12, PA SCREEN CURRENT SAMPLE
33	ANALOG NO. 13, PA PLATE CURRENT SAMPLE
34	ANALOG NO. 14, INPUT AMPLE CATHODE CURRENT SAMPLE
35	ANALOG NO. 15, INPUT AMPLE SCREEN DC VM SAMPLE
36	ANALOG NO. 16, INPUT AMPL PLATE DC VM SAMPLE
37	ANALOG NO. 17, DRIVER CATHODE CURRENT SAMPLE
38	ANALOG NO. 18, DRIVER SCREEN DC VM SAMPLE
39	ANALOG NO. 19, DRIVER PLATE DC VM SAMPLE
40	ANALOG NO. 20, PA GRID VOLTAGE SAMPLE
41	ANALOG NO. 21, PA CATHODE DC VM SAMPLE
42	ANALOG NO. 22, PA PLATE DC VM SAMPLE
43	ANALOG NO. 23, INTERNAL +28 VDC POWER
44	ANALOG NO. 24, REGULATED AC VM SAMPLE
45	ANALOG NO. 25, SPARE (10 V FULL SCALE)
46	ANALOG NO. 26, SPARE (10V FULL SCALE)
47	ANALOG NO. 27, SPARE (10 V FULL SCALE)
48	ANALOG NO. 28, SPARE (10 V FULL SCALE)
49	ANALOG NO. 29, SPARE (10 V FULL SCALE)
50	ANALOG NO. 30, SPARE (10 V FULL SCALE)
51	ANALOG NO. 31, SPARE (10 V FULL SCALE)
52	ANALOG NO. 32, VM PROBE (10 V FULL SCALE)
53	RANGE SELECT NO. 1
54	RANGE SELECT NO. 2
55	RANGE SELECT NO. 3
56	RANGE SELECT NO. 4
57	RANGE SELECT NO. 5
58	RANGE SELECT NO. 6
59	RANGE SELECT NO. 7
60	RANGE SELECT NO. 8
61	NOT USED
62	NOT USED
63	NOT USED
64	NOT USED
65	NOT USED
66	NOT USED
67	NOT USED
68	NOT USED
69	SHELL COMMON
70	SHELL COMMON
71	SHELL COMMON
72	SHELL COMMON
73	+12 VDC POWER
74	+12 VDC POWER
75	+5 VDC POWER
76	+5 VDC POWER
77	-12 VDC POWER
78	-12 VDC POWER
79	+5 VDC POWER
80	+5 VDC POWER

Figure 7-1. Backplane Assembly 1A12, Pin Function and Connector Identification Diagram (Sheet 2 of 3)

50	ANALOG NO. 26, SPARE (10 V FULL SCALE)	129	GROUND
51	ANALOG NO. 15, INPUT AMPL SCREEN DC VM SAMPLE	130	GROUND
52	ANALOG NO. 16, INPUT AMPL PLATE DC VM SAMPLE	131	GROUND
53	ANALOG NO. 27, SPARE (10 V FULL SCALE)	132	GROUND
54	INPUT AMPL BIAS CONTROL (HV SIDE)	133	SPARE
55	VSWR OVERLOAD THRESHOLD	134	MONITOR BUS
56	VSWR OVERLOAD SENSOR SAMPLE	135	CONTROL BUS
57	GROUND	136	CARRIER BUS
58	ANTENNA INTERLOCK	137	NOT USED
59	CIRCUIT BREAKER INTERLOCK	138	MONITOR BUS RETURN
60	PA SCREEN CURRENT OVERLOAD THRESHOLD	139	CONTROL BUS RETURN
61	GROUND	140	CARRIER BUS RETURN
62	ACCESS PLUG INTERLOCK	141	GROUND
63	RF PROVE	142	GROUND
64	AIR/TEMP INTERLOCK	143	GROUND
65	INPUT AMPL BIAS CONTROL (LV SIDE)	144	GROUND
66	ANALOG NO. 28, SPARE (10 V FULL SCALE)	145	+28 VDC CCCS POWER
67	-39 VDC IGC SUPPLY	146	SPACE USED FOR PIN 145
68	ANALOG NO. 29, SPARE (10 V FULL SCALE)	147	+28 VDC CCCS POWER COMMON
69	GROUND	148	SPACE USED FOR PIN 147
70	SERVO MOTOR, REGULATOR (1)	149	SPACE USED FOR PIN 145
71	SERVO MOTOR, REGULATOR (1)	150	SPACE USED FOR PIN 145
72	SERVO FOLLOW-UP POT, SECONDARY TUNING (SLIDER)	151	SPACE USED FOR PIN 147
73	GROUND	152	SPACE USED FOR PIN 147
74	SERVO GROUND (PHASE DISCRIMINATOR, SECONDARY TUNING)	153	+28 VDC SERVO AND RELAY POWER
75	SERVO FOLLOW-UP POT, PRIMARY TUNING (SLIDER)	154	SPACE USED FOR PIN 153
76	SERVO GROUND (PHASE DISCRIMINATOR, PRIMARY TUNING)	155	+28 VDC SERVO AND RELAY COMMON
77	TACHOMETER, PRIMARY TUNING (2)	156	SPACE USED FOR PIN 155
78	TACHOMETER, PRIMARY TUNING (1)	157	SPACE USED FOR PIN 153
79	PHASE DISCRIMINATOR, SECONDARY TUNING	158	SPACE USED FOR PIN 153
80	PHASE DISCRIMINATOR, PRIMARY TUNING	159	SPACE USED FOR PIN 155
		160	SPACE USED FOR PIN 155

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Figure 7-1. Backplane Assembly 1A12, Pin Function and Connector Identification Diagram (Sheet 3 of 3)

P/O CONNECTOR 1A12J5

PIN	FUNCTION
81	TUNE SEQUENCE POSITION BIT B
82	TUNE SEQUENCE POSITION BIT C
83	ANTENNA INTERLOCK
84	REGULATOR FAULT MONITOR
85	TUNE SEQUENCE POSITION BIT A
86	SERVO ERROR BIT 1
87	SERVO ERROR BIT 2
88	BLOWER TRANSFER MONITOR
89	SERVO MODE, DRIVER TUNING
90	SERVO MODE, PRIMARY TUNING
91	SERVO MODE, SECONDARY TUNING
92	SERVO MODE, LOADING
93	NOT USED
94	NOT USED
95	NOT USED
96	NOT USED
97	CONTROL A
98	CONTROL B
99	CONTROL C
100	AUX FUNCTION OUT (SPARE)
101	HIGH/LOW POWER RELAY CONTROL
102	FILAMENT ENABLE
103	KEY ENABLE
104	EXCITER TUNE/OPERATE
105	NOT USED
106	HIGH VOLTAGE ENABLE
107	BACKPLANE INTERLOCK
108	PA TUNE
109	ERROR MONITOR REQUEST
110	AUTO/MANUAL
111	SERVO ACTIVATE
112	TUNE COMPLETE
113	RF INPUT SENSOR
114	FILAMENT TIMER
115	NOT USED
116	PA OPERATE REQUEST
117	NOT USED
118	NOT USED
119	NOT USED
120	+28 VDC SERVO AND RELAY POWER

PIN	FUNCTION
121	PA SCREEN CURRENT FAULT
122	PA PLATE CURRENT FAULT
123	KEY MONITOR
124	ACCESS PLUG INTERLOCK FAULT
125	CIRCUIT BREAKER FAU[illegible]
126	TUNE FAU[illegible]
127	REFLECTED POWER FAU[illegible]
128	SERVO DISABLE, DRIVER TUNING
129	NOT USED
130	SERVO DISABLE, PRIMARY TUNING
131	SERVO DISABLE, SECONDARY TUNING
132	SERVO DISABLE, LOADING
133	NOT USED
134	NOT USED
135	NOT USED
136	NOT USED
137	SPARE
138	NOT USED
139	NOT USED
140	POWER INTERRUPT
141	DATA (EIGHT BIT DELAYED)
142	CLOCK
143	TUNE START
144	SERVO ENABLE, DRIVER TUNING
145	DCU ADDRESS BIT NO. 1
146	DCU ADDRESS BIT NO. 2
147	DCU ADDRESS BIT NO. 3
148	DCU ADDRESS BIT NO. 4
149	CARRIER BUS
150	CONTROL BUS
151	MONITOR BUS
152	DCU ADDRESS BIT NO. 5
153	CARRIER BUS RETURN
154	CONTROL BUS RETURN
155	MONITOR BUS RETURN
156	+3 VDC (DCU ADDRESS STRAPPING)
157	GROUND
158	GROUND
159	GROUND
160	GROUND

CONNECTOR 1A12J6

PIN	FUNCTION
1	SHELL COMMON
2	ANALOG NO. 13, PA PLATE CURRENT SAMPLE
3	NOT USED
4	ANALOG NO. 12, SCREEN CURRENT SAMPLE
5	GROUND
6	GROUND
7	ANALOG NO. 1, RF INPUT VM SAMPLE
8	ANALOG NO. 3, DRIVER GRID RF VM SAMPLE
9	ANALOG NO. 4, PA GRID RF VM SAMPLE
10	ANALOG NO. 20, PA GRID VOLTAGE SAMPLE
11	NOT USED
12	NOT USED
13	NOT USED
14	NOT USED
15	NOT USED
16	ANALOG NO. 6, FORWARD POWER SAMPLE
17	ANALOG NO. 7, REFLECTED POWER SAMPLE
18	ANALOG NO. 5, PA PLATE RF VM SAMPLE
19	ANALOG NO. 17, DRIVER CATHODE CURRENT SAMPLE
20	ANALOG NO. 18, DRIVER SCREEN DC VM SAMPLE
21	NOT USED
22	NOT USED
23	NOT USED
24	NOT USED
25	NOT USED
26	ANALOG NO. 15, INPUT AMPL SCREEN DC VM SAMPLE
27	NOT USED
28	ANALOG NO. 22, PA PLATE DC VM SAMPLE
29	AUX KEY ENABLE
30	SHELL COMMON
31	SHELL COMMON
32	SHELL COMMON
33	NOT USED
34	NOT USED
35	ANALOG NO. 16, INPUT AMPL PLATE DC VM SAMPLE
36	ANALOG NO. 21, PA CATHODE DC VM SAMPLE
37	+5 VDC POWER
38	+12 VDC POWER
39	-12 VDC POWER
40	ANALOG NO. 19, DRIVER PLATE DC VM SAMPLE

PIN	FUNCTION
41	ANALOG NO. 32, VM PROBE (10 V FULL SCALE)
42	ANALOG NO. 14, INPUT AMPL CATHODE CURRENT SAMPLE
43	RF INPUT SENSOR SAMPLE
44	SPARE
45	NOT USED
46	NOT USED
47	DCU ADDRESS BIT NO. 1
48	GROUND
49	NOT USED
50	+3 VDC (DCU ADDRESS STRAPPING)
51	DCU ADDRESS BIT NO. 2
52	GROUND
53	NOT USED
54	+3 VDC (DCU ADDRESS STRAPPING)
55	DCU ADDRESS BIT NO. 3
56	GROUND
57	NOT USED
58	+3 VDC (DCU ADDRESS STRAPPING)
59	DCU ADDRESS BIT NO. 4
60	GROUND
61	NOT USED
62	+3 VDC (DCU ADDRESS STRAPPING)
63	DCU ADDRESS BIT NO. 5
64	GROUND
65	NOT USED
66	+3 VDC (DCU ADDRESS STRAPPING)
67	NOT USED
68	SPARE
69	CARRIER BUS
70	CARRIER BUS
71	CARRIER BUS RETURN
72	CARRIER BUS RETURN
73	CONTROL BUS
74	CONTROL BUS
75	CONTROL BUS RETURN
76	CONTROL BUS RETURN
77	MONITOR BUS
78	MONITOR BUS
79	MONITOR BUS RETURN
80	MONITOR BUS RETURN

CONNECTOR 1A12J7

PIN	FUNCTION
1	SERVO MOTOR, DRIVER TUNING (+)
2	SERVO MOTOR, PRIMARY TUNING (1)
3	SERVO MOTOR, SECONDARY TUNING (1)
4	SERVO MOTOR, LOADING (1)
5	SERVO MOTOR, DRIVER TUNING (+)
6	SERVO MOTOR, PRIMARY TUNING (1)
7	SERVO MOTOR, SECONDARY TUNING (1)
8	SERVO MOTOR, LOADING (1)
9	SERVO MOTOR, DRIVER TUNING (-)
10	SERVO MOTOR, PRIMARY TUNING (2)
11	SERVO MOTOR, SECONDARY TUNING (2)
12	SERVO MOTOR, LOADING (2)
13	SERVO MOTOR, DRIVER TUNING (-)
14	SERVO MOTOR, PRIMARY TUNING (2)
15	SERVO MOTOR, SECONDARY TUNING (2)
16	SERVO MOTOR, LOADING (2)
17	ANALOG NO. 3, DRIVER GRID RF VM SAMPLE
18	ANALOG NO. 1, RF INPUT VM SAMPLE
19	ANALOG NO. 20, PA GRID VOLTAGE SAMPLE
20	ANALOG NO. 4, PA GRID RF VM SAMPLE
21	GROUND
22	ANALOG NO. 7 REFLECTED POWER SAMPLE
23	ANALOG NO. 5, PA PLATE RF VM SAMPLE
24	ANALOG NO. 6, FORWARD POWER SAMPLE
25	GROUND
26	AUX KEY RETURN
27	RF INPUT SENSOR SAMPLE
28	PA PLATE CURRENT OVERLOAD THRESHOLD
29	SHELL COMMON
30	SHELL COMMON
31	SERVO MOTOR REGULATOR (2)
32	SERVO MOTOR REGULATOR (2)
33	GROUND
34	POWER SUPPLY UNIT 2 COMMON
35	RF UNIT 1 COMMON
36	TUNE POWER CONTROL (COLLECTOR)
37	GROUND
38	ANALOG NO. 14, INPUT AMPL CATHODE CURRENT SAMPLE
39	ANALOG NO. 17, DRIVER CATHODE CURRENT SAMPLE
40	ANALOG NO. 18, DRIVER SCREEN DC VM SAMPLE
41	ANALOG NO. 19, DRIVER PLATE DC VM SAMPLE
42	ANALOG NO. 21, PA CATHODE DC VM SAMPLE
43	ANALOG NO. 23, INTERNAL +28 VDC POWER
44	ANALOG NO. 22 PA PLATE DC VM SAMPLE
45	GROUND
46	AUX KEY ENABLE
47	ANALOG NO. 2, ALC/TGC
48	ANALOG NO. 25, SPARE (10 V FULL SCALE)
49	GROUND
50	ANALOG NO. 26, SPARE (10 V FULL SCALE)
51	ANALOG NO. 15, INPUT AMPL SCREEN DC VM SAMPLE
52	ANALOG NO. 16, INPUT AMPL PLATE DC VM SAMPLE
53	ANALOG NO. 27, SPARE (10 V FULL SCALE)
54	INPUT AMPL BIAS CONTROL (HV SIDE)
55	VSWR OVERLOAD THRESHOLD
56	VSWR OVERLOAD SENSOR SAMPLE
57	GROUND
58	ANTENNA INTERLOCK
59	CIRCUIT BREAKER INTERLOCK
60	PA SCREEN CURRENT OVERLOAD THRESHOLD
61	GROUND
62	ACCESS PLUG INTERLOCK
63	RF PROVE
64	AIR/TEMP INTERLOCK
65	INPUT AMPL BIAS CONTROL (LV SIDE)
66	ANALOG NO. 28, SPARE (10 V FULL SCALE)
67	-39 VDC IGC SUPPLY
68	ANALOG NO. 29, SPARE (10 V FULL SCALE)
69	GROUND
70	SERVO MOTOR, REGULATOR (1)
71	SERVO MOTOR, REGULATOR (1)
72	SERVO FOLLOW-UP POT, SECONDARY TUNING (SLIDER)
73	GROUND
74	SERVO GROUND (PHASE DISCRIMINATOR, SECONDARY TUNING)
75	SERVO FOLLOW-UP POT, PRIMARY TUNING (SLIDER)
76	SERVO GROUND (PHASE DISCRIMINATOR, PRIMARY TUNING)
77	TACHOMETER, PRIMARY TUNING (2)
78	TACHOMETER, PRIMARY TUNING (1)
79	PHASE DISCRIMINATOR, SECONDARY TUNING
80	PHASE DISCRIMINATOR, PRIMARY TUNING

PIN	FUNCTION
81	+12 VDC POWER
82	-12 VDC POWER
83	-12 VDC POWER
84	REGULATOR FAULT MONITOR
85	SERVO FOLLOW-UP POT, DRIVER TUNING (CCW)
86	SERVO FOLLOW-UP POT, PRIMARY TUNING (CW)
87	SERVO FOLLOW-UP POT, SECONDARY TUNING (CW)
88	SERVO FOLLOW-UP POT, LOADING (CCW)
89	SERVO FOLLOW-UP POT, DRIVER TUNING (CW)
90	SERVO FOLLOW-UP POT, PRIMARY TUNING (CCW)
91	SERVO FOLLOW-UP POT, SECONDARY TUNING (CCW)
92	SERVO FOLLOW-UP POT, LOADING (CW)
93	GROUND
94	ANALOG NO. 30, SPARE (10 V FULL SCALE)
95	ANALOG NO. 31, SPARE (10 V FULL SCALE)
96	BLOWER TRANSFER MONITOR
97	GROUND
98	NOT USED
99	NOT USED
100	AUX FUNCTION OUT (SPARE)
101	GROUND
102	TUNE COMPLETE
103	TGC INHIBIT
104	NOT USED
105	TUNE FAULT
106	TUNE RESISTOR CONTROL
107	ALC CONTROL INPUT (IGC SAMPLE)
108	SERVO GROUND (PHASE DISCRIMINATOR, DRIVER TUNING)
109	TUNE POWER LEVEL SAMPLE
110	ANODE DISSIPATION LIMITER (RF SAMPLE)
111	PHASE DISCRIMINATOR, DRIVER TUNING
112	SERVO FOLLOW-UP POT, DRIVER TUNING (SLIDER)
113	TACHOMETER, LOADING (1)
114	DRIVER GRID OVERDRIVE CONTROL (IGC INPUT)
115	LOADING COMPARATOR
116	TACHOMETER, LOADING (2)
117	ANODE DISSIPATION LIMITER (PLATE CURRENT THRESHOLD)
118	SERVO FOLLOW-UP POT, LOADING (SLIDER)
119	PA PLATE CURRENT SAMPLE
120	PA SCREEN CURRENT SAMPLE
121	PA KEYLINE
122	ALC /TGC RELAY CONTROL
123	REGULATOR SENSOR
124	REGULATOR SENSOR REFERENCE
125	BLOWER CONTROL
126	FILAMENT CONTROL
127	HIGH/LOW POWER RELAY CONTROL
128	HIGH VOLTAGE CONTROL
129	GROUND
130	GROUND
131	GROUND
132	GROUND
133	SPARE
134	MONITOR BUS
135	CONTROL BUS
136	CARRIER BUS
137	NOT USED
138	MONITOR BUS RETURN
139	CONTROL BUS RETURN
140	CARRIER BUS RETURN
141	GROUND
142	GROUND
143	GROUND
144	GROUND
145	+28 VDC CCCS POWER
146	SPACE USED FOR PIN 145
147	+28 VDC CCCS POWER COMMON
148	SPACE USED FOR PIN 147
149	SPACE USED FOR PIN 145
150	SPACE USED FOR PIN 145
151	SPACE USED FOR PIN 147
152	SPACE USED FOR PIN 147
153	+28 VDC SERVO AND RELAY POWER
154	SPACE USED FOR PIN 153
155	+28 VDC SERVO AND RELAY COMMON
156	SPACE USED FOR PIN 155
157	SPACE USED FOR PIN 153
158	SPACE USED FOR PIN 153
159	SPACE USED FOR PIN 155
160	SPACE USED FOR PIN 155

Figure 7-1 Backplane Assembly 1A12 Pin Function and Connector Identification Diagram (Sheet 3 of 3)

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
NA	Changed function name at 1A12J7, pin 103, from ARC FAULT to TGC INHIBIT.		
NA	Changed CCCS CONTROL callout to CONTROL.		
NA	Corrected 1A12J2, pin 78, to read pin 79. Corrected connection of 1A12J4, pins 65 and 66, from SYSTEM GROUND connections to +28 VDC SERVO AND RELAY COMMON connections.		

Figure 7-2. Backplane Assembly 1A12, Interconnect Diagram (Sheet A)

Figure 7-2. Backplane Assembly 1A12, Interconnect Diagram (Sheet 1 of 2)

IMPORTANT: READ ALL NOTES CAREFULLY. NUMBERS IN ⬡ APPLY TO SPECIFIC NOTE.

WIRE FUNCTION	1A12J7 MATES WITH 1A10 1P18	1A12J6 MATES WITH 1A24P1	1A12J1 MATES WITH 1A7P1	1A12J2 MATES WITH 1A8P1	1A12J3 MATES WITH 1A9P1	1A12J4 MATES WITH 1A10P1	1A12J5 MATES WITH 1A11P1
ACCESS PLUG INTERLOCK	62		51				
ACCESS PLUG INTERLOCK			52		104		
ACCESS PLUG INTERLOCK					101	59	
ACCESS PLUG INTERLOCK FAULT						116	124
AIR INTERLOCK	64					47	
ALC CONTROL INPUT (IGC SAMPLE)	107				129		
ALC/TGC RELAY CONTROL	122					129	
ANALOG ADDRESS NO. 1							5
ANALOG ADDRESS NO. 2							6
ANALOG ADDRESS NO. 3							7
ANALOG ADDRESS NO. 4							8
ANALOG ADDRESS NO. 5							9
ANALOG ADDRESS NO. 6							10
ANALOG ADDRESS NO. 7							11
ANALOG ADDRESS NO. 8							12
ANALOG ADDRESS NO. 9							13
ANALOG ADDRESS NO. 10							14
ANALOG ADDRESS NO. 11							15
ANALOG ADDRESS NO. 12							16
ANALOG ADDRESS NO. 13							17
ANALOG ADDRESS NO. 14							18
ANALOG ADDRESS NO. 15							19
ANALOG ADDRESS NO. 16							20
RANGE SELECT NO. 8							60
RANGE SELECT NO. 7							59
RANGE SELECT NO. 6							58
RANGE SELECT NO. 5							57
RANGE SELECT NO. 4							56
RANGE SELECT NO. 3							55
RANGE SELECT NO. 2							54
RANGE SELECT NO. 1							53
ANALOG NO. 1, RF INPUT VM SAMPLE	18	7					21
ANALOG NO. 2, ALC/TGC (10V FULL SCALE)	47						22
ANALOG NO. 3, DRIVER GRID RF VM SAMPLE	17	8					23
ANALOG NO. 4, PA GRID RF VM SAMPLE	20	9					24
ANALOG NO. 5, PA PLATE RF VM SAMPLE	23	18					25
ANALOG NO. 6, FORWARD POWER SAMPLE	24	16					26
ANALOG NO. 7, REFLECTED POWER SAMPLE	22	17					27
ANALOG NO. 8, SERVO POSITION, DRIVER TUNING					118		28
ANALOG NO. 9, SERVO POSITION, PRIMARY TUNING					68		29
ANALOG NO. 10, SERVO POSITION, SECONDARY TUNING					94		30
ANALOG NO. 11, SERVO POSITION, LOADING					114		31
ANALOG NO. 12, PA SCREEN CURRENT SAMPLE	4				142		32
ANALOG NO. 13, PA PLATE CURRENT SAMPLE	2				105		33
ANALOG NO. 14, INPUT AMPL CATHODE CURRENT SAMPLE	38	42					34
ANALOG NO. 15, INPUT AMPL SCREEN DC VM SAMPLE	51	26					35
ANALOG NO. 16, INPUT AMPL PLATE DC VM SAMPLE	52	35					36
ANALOG NO. 17, DRIVER CATHODE CURRENT SAMPLE	39	19					37
ANALOG NO. 18, DRIVER SCREEN DC VM SAMPLE	40	20					38
ANALOG NO. 19, DRIVER PLATE DC VM SAMPLE	41	40					39
ANALOG NO. 20, PA GRID VOLTAGE SAMPLE	19	10					40
ANALOG NO. 21, PA CATHODE DC VM SAMPLE	42	36					41
ANALOG NO. 22, PA PLATE DC VM SAMPLE	44	25					42
ANALOG NO. 23, INTERNAL +28 VDC POWER	43						43
ANALOG NO. 24, REGULATED AC VM SAMPLE				146			44
ANALOG NO. 25, SPARE (10V FULL SCALE)	48						45
ANALOG NO. 26, SPARE (10V FULL SCALE)	50						46
ANALOG NO. 27, SPARE (10V FULL SCALE)	53						47
ANALOG NO. 28, SPARE (10V FULL SCALE)	66						48
ANALOG NO. 29, SPARE (10V FULL SCALE)	68						49
ANALOG NO. 30, SPARE (10V FULL SCALE)	94						50
ANALOG NO. 31, SPARE (10V FULL SCALE)	95						51
ANALOG NO. 32, VM PROBE (10V FULL SCALE)		41					52
ANODE DISSIPATION LIMITER (PLATE CURRENT THRESHOLD)	117				131		
ANODE DISSIPATION LIMITER (RF SAMPLE)	110				130		
ANTENNA INTERLOCK	58					63	83
TGC INHIBIT	103					64	
AUTO/MANUAL						10	110
AUX FUNCTION OUT (SPARE)	100						100
AUX KEY ENABLE	46	29				38	
BACKPLANE INTERLOCK					137		
BLOWER CONTROL	125					141	107
BLOWER TRANSFER MONITOR	96					137	88
CONTROL: CONTROL BUS	135	73					
CONTROL: CONTROL BUS RETURN	139	75					
CONTROL: CONTROL BUS		74					150
CONTROL: CONTROL BUS RETURN		76					154
CONTROL: CARRIER BUS	136	69					
CONTROL: CARRIER BUS RETURN	140	71					
CONTROL: CARRIER BUS		70					149
CONTROL: CARRIER BUS RETURN		72					153
CONTROL: MONITOR BUS	134	77					
CONTROL: MONITOR BUS RETURN	138	79					
CONTROL: MONITOR BUS		78					151
CONTROL: MONITOR BUS RETURN		80					155
CIRCUIT BREAKER FAULT						120	125
CIRCUIT BREAKER INTLK	59					51	
CLOCK						45	142
CONTROL A						50	97
CONTROL B						54	98
CONTROL C						58	99
DATA (EIGHT BIT DELAYED)						37	141
DCU ADDRESS BIT NO. 1		47					145
DCU ADDRESS BIT NO. 2		51					146
DCU ADDRESS BIT NO. 3		55					147
DCU ADDRESS BIT NO. 4		59					148
DCU ADDRESS BIT NO. 5		63					152
DEMAND SURVEILLANCE (NOT USED)					1		39
DRIVER GRID OVERDRIVE CONTROL (IGC INPUT)	114				121		
ERROR MONITOR REQUEST						42	109
EXCITER TUNE/OPERATE						26	104
FILAMENT CONTROL	126					149	
FILAMENT ENABLE						14	102
FILAMENT TIMER						34	114
HIGH/LOW POWER RELAY CONTROL	127						101
HIGH VOLTAGE CONTROL	128					153	
HIGH VOLTAGE ENABLE						18	106
INPUT AMPL BIAS CONTROL (HV SIDE)	54				49		
INPUT AMPL BIAS CONTROL (LV SIDE)	65				54		
KEY ENABLE						22	103
KEY MONITOR						112	123
LOADING COMPARATOR	115				93		
PHASE DISCRIMINATOR, DRIVER TUNING	111				99		
PHASE DISCRIMINATOR, PRIMARY TUNING	80				66		
PHASE DISCRIMINATOR, SECONDARY TUNING	79				57		
PA KEYLINE	121				124	133	
PA OPERATE REQUEST						89	116
PA PLATE CURRENT FAULT						105	122
PA PLATE CURRENT OVERLOAD					27	40	
PA PLATE CURRENT OVERLOAD THRESHOLD	28				23		
PA PLATE CURRENT SAMPLE	119				145		
PA READY (NOT USED)						93	
PA SCREEN CURRENT FAULT						104	121
PA SCREEN CURRENT OVERLOAD					138	44	
PA SCREEN CURRENT OVERLOAD THRESHOLD	60				51		
PA SCREEN CURRENT SAMPLE	120				141		
PA TUNE						147	108
POWER INTERRUPT						92	140
REFLECTED POWER FAULT						100	127
REGULATOR FAULT MONITOR	84						84
REGULATOR SENSOR	123				147		
REGULATOR REFERENCE	124				148		
RF INPUT SENSOR					38		
RF INPUT SENSOR SAMPLE	27	43			26	43	19
RF PROVE	63					55	
SERVO ACTIVATE						46	11
SERVO MODE, DRIVER TUNING						8	89
SERVO MODE, LOADING						20	92
SERVO MODE, PRIMARY TUNING						12	90
SERVO MODE, SECONDARY TUNING						16	91
SERVO MODE CONTROL, DRIVER TUNING					85	115	
SERVO MODE CONTROL, LOADING					97	127	
SERVO MODE CONTROL, PRIMARY TUNING					65	119	
SERVO MODE CONTROL, SECONDARY TUNING					82	123	
SERVO DISABLE, DRIVER TUNING							128
SERVO DISABLE, LOADING							132
SERVO DISABLE, PRIMARY TUNING							130
SERVO DISABLE, SECONDARY TUNING						15	131
SERVO ENABLE							144
SERVO ENABLE, DRIVER TUNING							
SERVO ENABLE, LOADING							
SERVO ENABLE, PRIMARY TUNING							
SERVO ENABLE, SECONDARY TUNING							
SERVO ERROR BIT 1							
SERVO ERROR BIT 2							
SERVO ERROR REQUEST, DRIVER TUNING							
SERVO ERROR REQUEST, LOADING							
SERVO ERROR REQUEST, PRIMARY TUNING							
SERVO ERROR REQUEST, SECONDARY TUNING							
SERVO FOLLOW-UP POT, DRIVER TUNING (CCW)	85	(SERVO FOLLOW-UP LOW)					
SERVO FOLLOW-UP POT, LOADING (CCW)	88						
SERVO FOLLOW-UP POT, PRIMARY TUNING (CW)	86						
SERVO FOLLOW-UP POT, SECONDARY TUNING (CW)	87						
SERVO FOLLOW-UP POT, DRIVER TUNING (CW)	89	(SERVO FOLLOW-UP HIGH)					
SERVO FOLLOW-UP POT, LOADING (CW)	92						
SERVO FOLLOW-UP POT, PRIMARY TUNING (CCW)	90						
SERVO FOLLOW-UP POT, SECONDARY TUNING (CCW)	91						

777-5558-001

Figure 7-2. Backplane Assembly 1A12, Interconnect Diagram (Sheet 1 of 2)

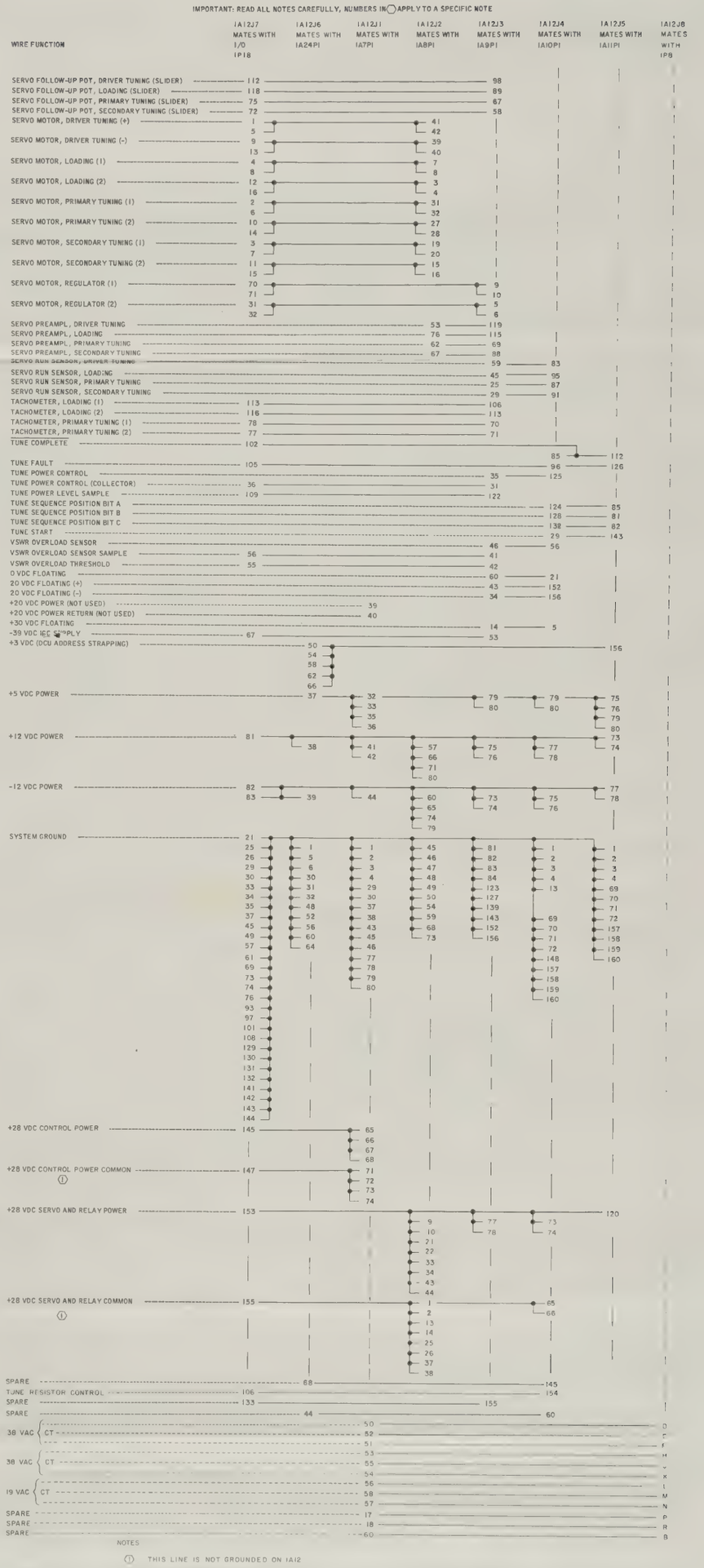
NOTES:

1. THIS LINE IS NOT GROUNDED ON 1A12.
2. THE FOLLOWING PINS ARE NOT USED:

1A12J1	5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 34, 47, 48, 49, 59, 61, 62, 63, 64, 69, 70, 75, 76.
1A12J2	5, 6, 11, 12, 17, 18, 23, 24, 29, 30, 35, 36, 55, 56, 61, 64, 69, 70, 75, 78.
1A12J3	2, 3, 4, 7, 8, 11, 12, 13, 15, 16, 17, 18, 19, 20, 22, 24, 28, 32, 36, 37, 40, 44, 48, 50, 56, 61, 63, 64, 72, 86, 87, 90, 91, 92, 95, 96, 100, 102, 103, 107, 108, 109, 110, 111, 112, 116, 117, 120, 124, 125, 128, 132, 133, 134, 135, 136, 140, 144, 149, 150, 151, 153, 154, 157, 158, 159, 160.
1A12J4	6, 23, 24, 25, 27, 28, 30, 31, 32, 33, 35, 36, 41, 48, 49, 52, 53, 57, 61, 67, 68, 81, 84, 88, 97, 98, 99, 101, 102, 103, 105, 106, 107, 109, 110, 111, 113, 117, 121, 130, 131, 134, 135, 136, 139, 140, 142, 143, 144, 146, 150, 151, 155.
1A12J5	61, 62, 63, 64, 65, 66, 67, 68, 93, 94, 95, 96, 105, 115, 117, 118, 119, 129, 133, 134, 135, 136, 137, 138, 139.
1A12J6	3, 11, 12, 13, 14, 15, 21, 22, 23, 24, 25, 27, 33, 34, 45, 46, 49, 53, 57, 61, 65, 67.
1A12J7	98, 99, 104, 137.
1A12J8	A, C

777-5558-001

Figure 7-2. Backplane Assembly 1A12, Interconnect Diagram (Sheet 2 of 2)



NOTES

① THIS LINE IS NOT GROUNDED ON 1A12

② THE FOLLOWING PINS ARE NOT USED:

1A12J1	5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 34, 47, 48, 49, 59, 61, 62, 63, 64, 69, 70, 75, 76
1A12J2	5, 6, 11, 12, 17, 18, 23, 24, 29, 30, 35, 36, 55, 56, 61, 64, 69, 70, 75, 78.
1A12J3	2, 3, 4, 7, 8, 11, 12, 13, 15, 16, 17, 18, 19, 20, 22, 24, 28, 32, 36, 37, 40, 44, 48, 50, 56, 61, 63, 64, 72, 86, 87, 90, 91, 92, 95, 96, 100, 102, 103, 107, 108, 109, 110, 111, 112, 116, 117, 120, 124, 125, 128, 132, 133, 134, 135, 136, 140, 144, 149, 150, 151, 153, 154, 157, 158, 159, 160.
1A12J4	6, 23, 24, 25, 27, 28, 30, 31, 32, 33, 35, 36, 41, 48, 49, 52, 53, 57, 61, 67, 68, 81, 84, 88, 97, 98, 99, 101, 102, 103, 105, 106, 107, 109, 110, 111, 113, 117, 121, 130, 131, 134, 135, 136, 139, 140, 142, 143, 144, 146, 150, 151, 155.
1A12J5	61, 62, 63, 64, 65, 66, 67, 68, 93, 94, 95, 96, 105, 115, 117, 118, 119, 129, 133, 134, 135, 136, 137, 138, 139
1A12J6	3, 11, 12, 13, 14, 15, 21, 22, 23, 24, 25, 27, 33, 34, 45, 46, 49, 53, 57, 61, 65, 67
1A12J7	98, 99, 104, 137.
1A12J8	A, C

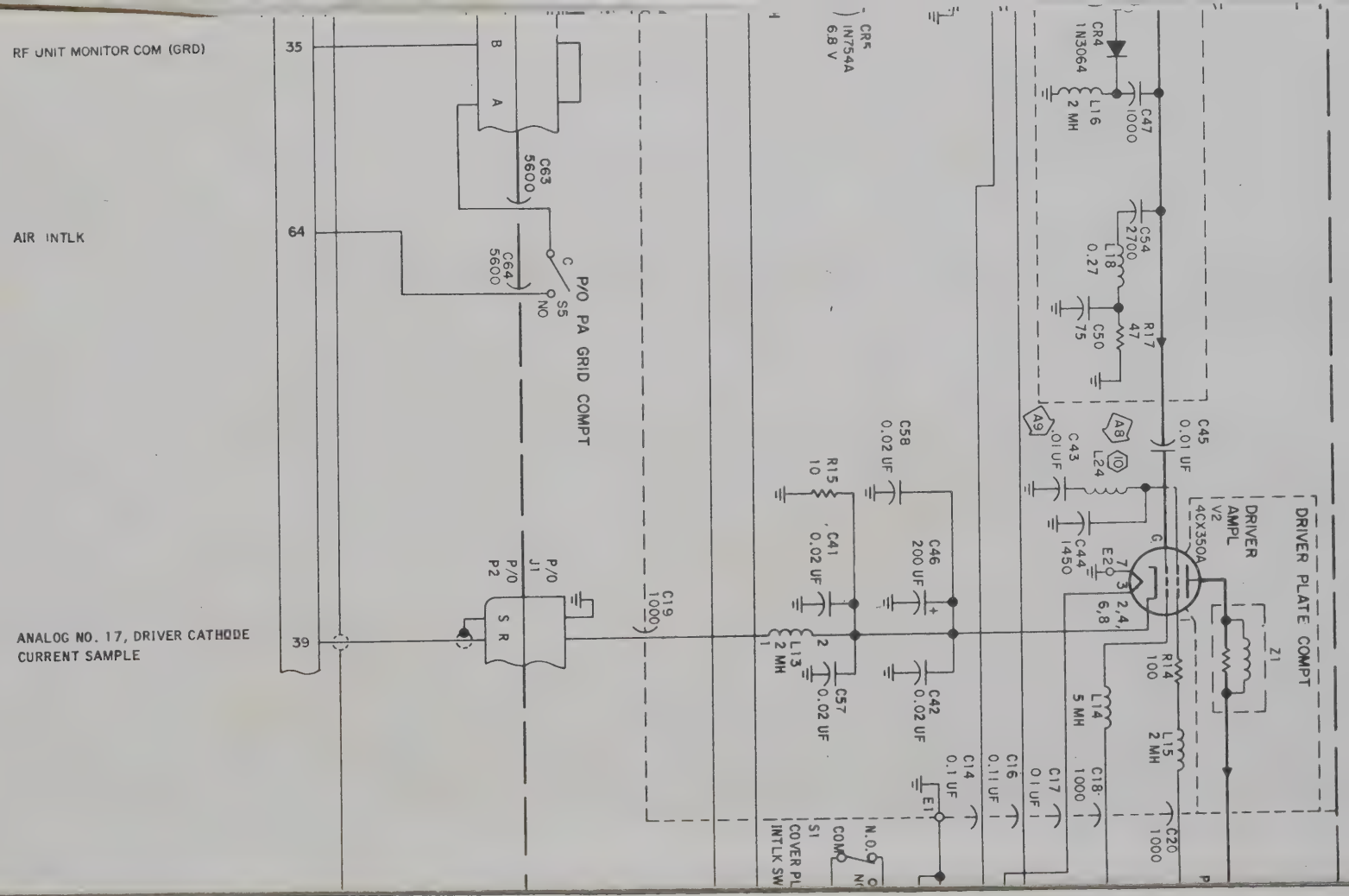
Figure 7-2. Backplane Assembly 1A12, Interconnect Diagram (Sheet 2 of 2)

777-5556-00

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Added 1R14 bleeder resistor across capacitor 1C9 to protect primary tuning discriminator components.		CI-71143
A2	Added 1A21TB1CR9 and 1A21TB1CR10 to provide additional overvoltage protection for loading coil.		CI-71163
A3	Changed 1A16CR1-4 from HD1811 to 1N5711.		CI-72323
A4	Changed 1A17TB1CR1, 1A17TB1CR2, and 1A20CR1 from 1N3070 to 1N3064 to improve reliability of plate and grid loading sample diodes.		CI-71195
A5	Changed 1A4R3 from 3300 ohms to 27 kilohms to improve primary tuning servo stability.		CI-71434
A6	Added antenna interlock buffer circuit to 1A23 to protect logic circuits from damage by transients on rf line.		CI-71443
A7	1A17L1 changed from 2 mH to 5 mH.		CI-70035
A8	Added 1A1L23 and 1A1L24.		CI-72373
A9	Changed 1A1C32 and 1A1C43 from 1000 pF to 0.01 μF.		CI-72343
B1	Changed A21R23 from 12 kilohms to 4.7 kilohms. Changed A21R30 from 12 kilohms to 8.2 kilohms. Changed A21R31 from 3.9 kilohms to 1.8 kilohms.		CI-73033
C1	Deleted 1A17C17. Corrected schematic diagram component value errors.		REV R
NA	Deleted connection from 1A17C1 to 1A17V1A-1. Added connection from 1A17C1 to 1A17V1B-2.		REV T
B2	Added 1A1R25. Added ANALOG NO 2 ALC/ TGC signal line from 1A1R25 to P18-47 by way of P2-a.		REV U

Figure 7-3. RF Amplifier, Unit 1, Schematic Diagram (Sheet A)


RF UNIT MONITOR COM (GRD)
AIR INTLK
ANALOG NO. 17, DRIVER CATHODE CURRENT SAMPLE
35
64
39
P/O PA GRID COMPT
DRIVER PLATE COMPT
DRIVER AMPL V2 4CX350A
CR4 1N3064
CR5 1N754A 6.8 V
C47 1000
L16 2 MH
C54 2700
L18 0.27
C50 75
R17 47
C45 0.01 UF
C43 .01 UF
L24
C44 1450
E2
Z1
R14 100
L15 2 MH
L14 5 MH
C18 1000
C20 1000
C17 0.1 UF
C16 0.11 UF
C14 0.1 UF
E1
C58 0.02 UF
C46 200 UF
C42 0.02 UF
R15 10
C41 0.02 UF
L13 2 MH
C57 0.02 UF
C19 1000
C63 5600
C64 5600
S5
P/O J1
P/O P2
S1 COVER PL INTLK SW
COM
N.O.

VOLTAGE MEASUREMENTS

POINT OF TEST	E	B	C	NOTES
1A1Q1				Do not measure dc voltages on this transistor.
Input amplifier screen voltage (1P5-S)				+250 Vdc nominal.

Test point voltages, other than transistor voltages, may be found as analog readouts on the maintenance display unit. Refer to the maintenance manual, TO 31S1-2TSC60-12, for further information.

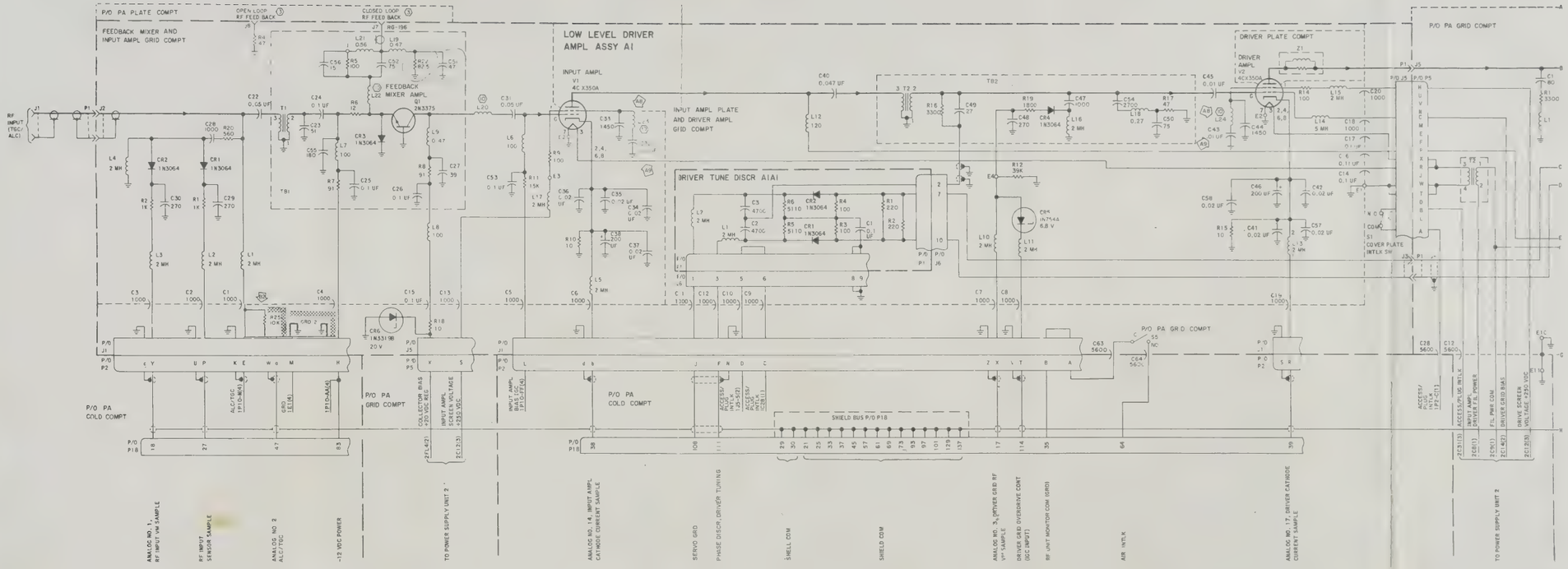


Figure 7-3. RF Amplifier, Unit 1, Schematic Diagram (Sheet 1 of 4)

T CONNECT

NOTES:

1. NUMBERS IN PARENTHESES () DENOTE SHEET OF SCHEMATIC.
2. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
3. RF FEEDBACK CONNECTOR P3 SHOULD BE TERMINATED IN A1J7 UNLESS TESTING REQUIRES REMOVAL OF RF FEEDBACK. TERMINATE P3 IN A1J8 FOR PHASE MEASUREMENTS AT TP1 AND TP2.
4. IF INTERNAL +28 VDC SUPPLY IS USED, JUMPER TB1-2 TO TB1-3 AND TB1-5 TO TB1-6. IF STATION BATTERY IS USED, JUMPER TB1-1 TO TB1-2 AND TB1-4 TO TB1-5. EITHER TERMINAL OF THE STATION BATTERY MAY BE GROUNDED.
5. J2-U AND J2-S ARE JUMPERED IF NO AUXILIARY INTERLOCKS ARE REQUIRED. IF AN UNGROUNDED ANTENNA IS USED, J2-U MUST BE RETURNED TO J2-T. AUXILIARY INTERLOCKS ARE TIED BETWEEN J2-U AND J2-S.
6. AUXILIARY KEY ENABLE WHEN CONNECTED TO GROUND (AUXILIARY RETURN) WILL KEY THE AMPLIFIER.
7. INTERLOCK SWITCHES ARE SHOWN WITH PANELS IN PLACE.
8. CAPACITORS C58 THROUGH C61 ARE IN PARALLEL.
9. ALL COMPONENTS OF ADJUSTMENT PANEL ASSEMBLY 1A21, EXCEPT POTENTIOMETERS 1A21R1 THROUGH 1A21R12 AND RELAYS 1A21K1 AND 1A21K2, ARE A PART OF TERMINAL BOARD 1A21TB1.
10. INDICATED COILS ARE FERRITE BEADS.

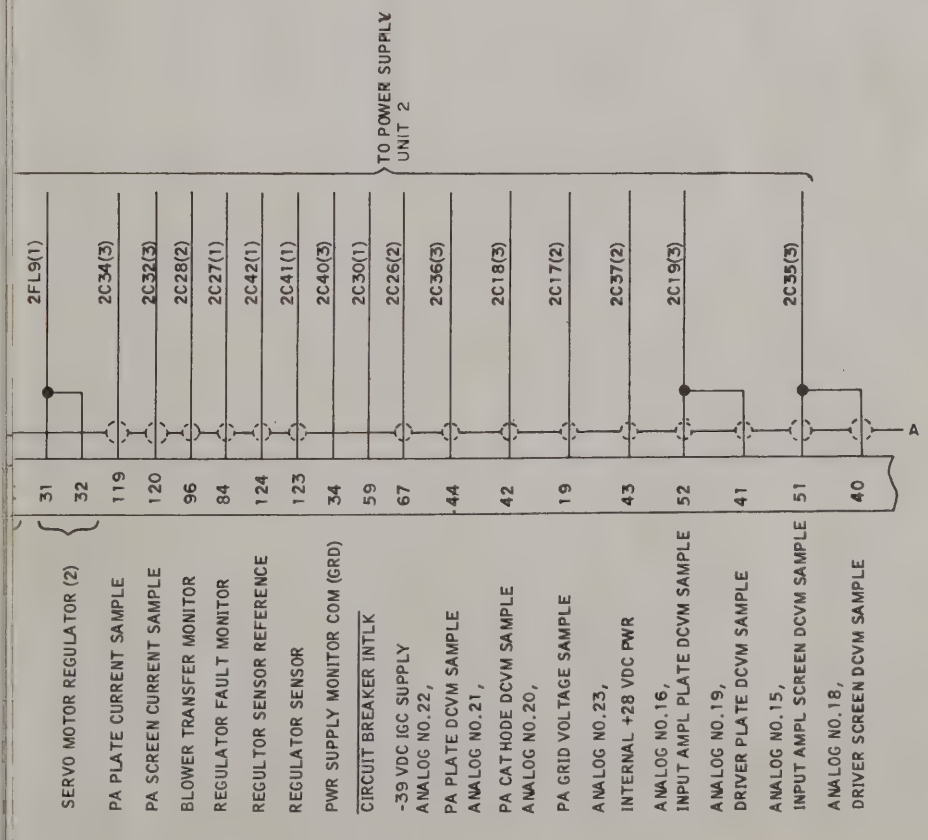


Figure 7-3. RF Amplifier, Unit 1, Schematic Diagram (Sheet 3 of 4)

VOLTAGE MEASUREMENTS

POINT OF TEST	E	B	C	NOTES
1A22Q1				Inaccessible
1A22Q2				Inaccessible
1A25Q1	GND	0.0	+28.0	

Values shown are dc voltages with respect to chassis ground.

Test conditions: 400-Hz input power, nominal loads, plate on, high-power operation, equipment keyed.

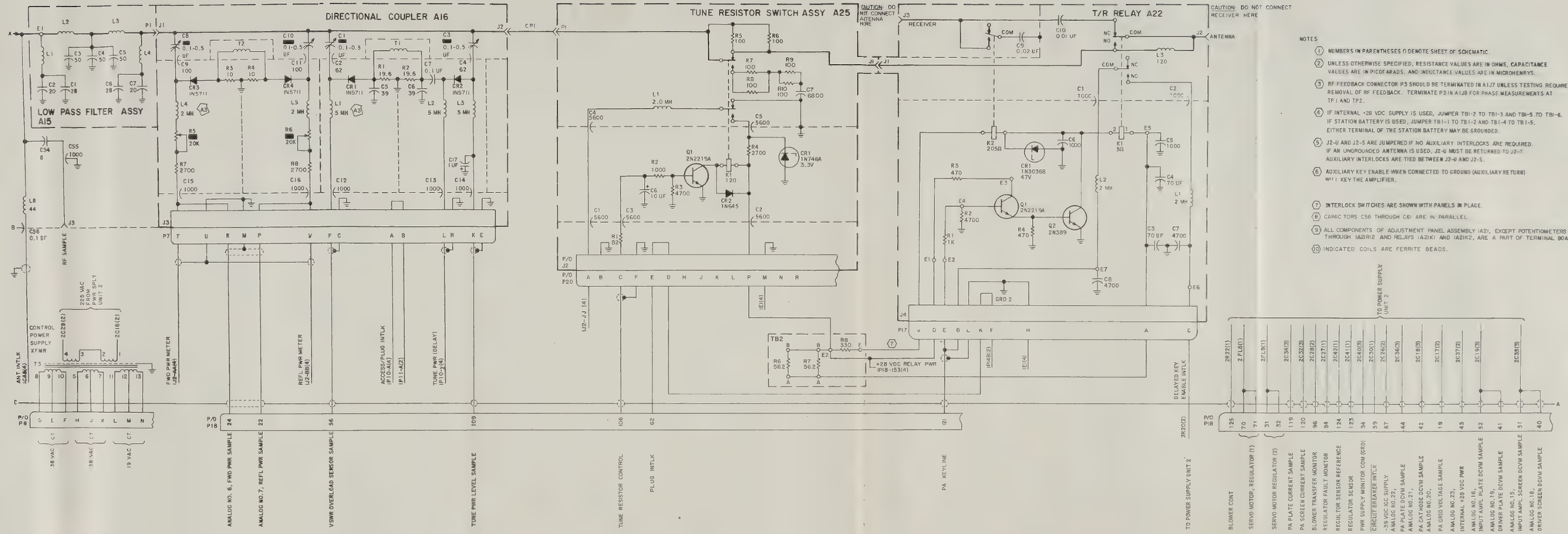


Figure 7-3. RF Amplifier, Unit 1, Schematic Diagram (Sheet 3 of 4)

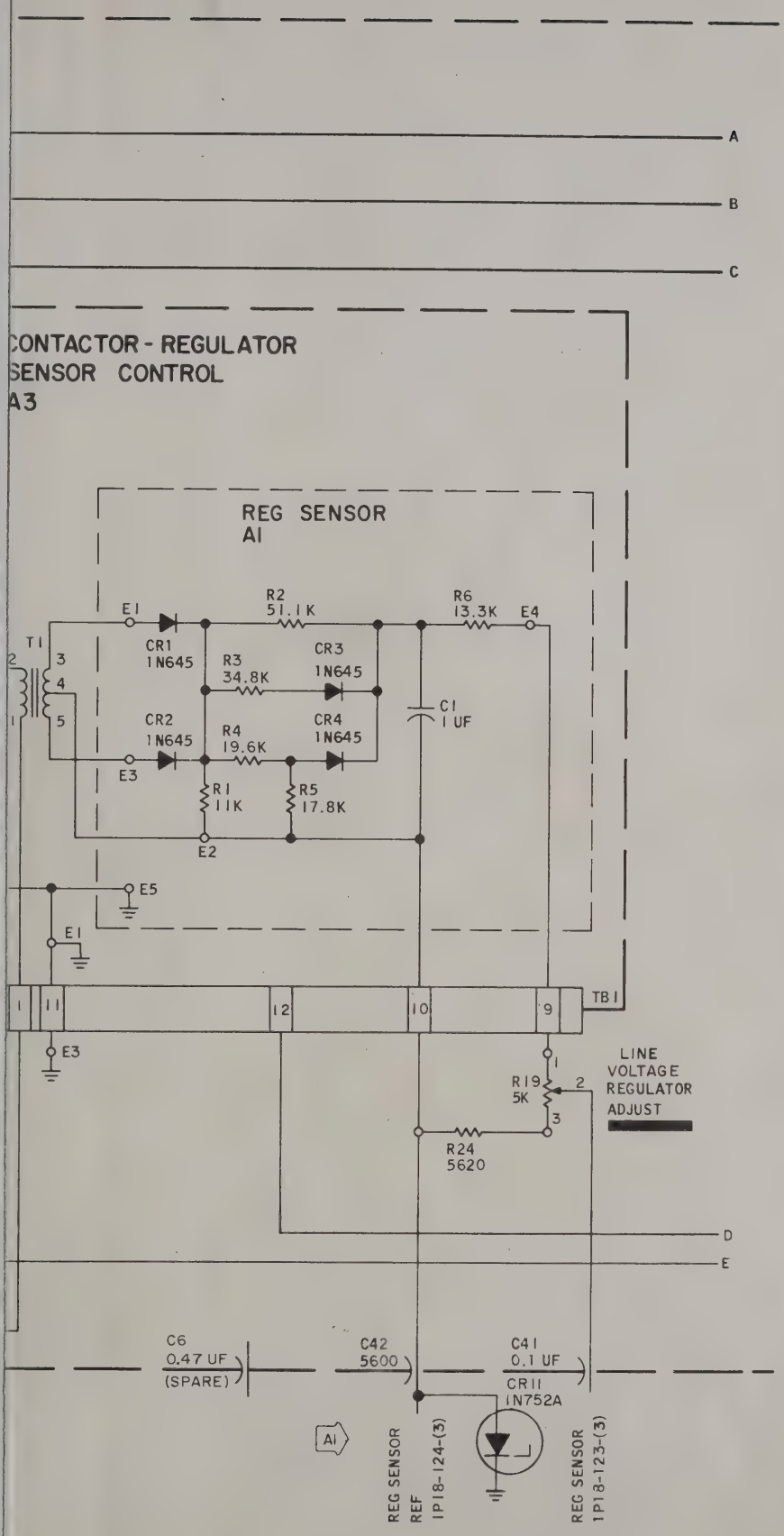


Figure 7-4. Power Supply, Unit 2, Schematic Diagram (Sheet 1 of 3)

VOLTAGE MEASUREMENTS

POINT OF TEST	E	B	C	NOTES
2A3A2Q1	Gnd	+0.8	+1.2	
2A3A2Q2	Gnd	+0.8	+0.5	
2A3A2Q3	+0.6	+1.3	+0.6	
2A3A2Q4	Gnd	+0.6	+0.6	

Values shown are dc voltages with respect to chassis ground.

Test conditions: 400-Hz input power, nominal loads, plate on, high-power operation; equipment keyed.

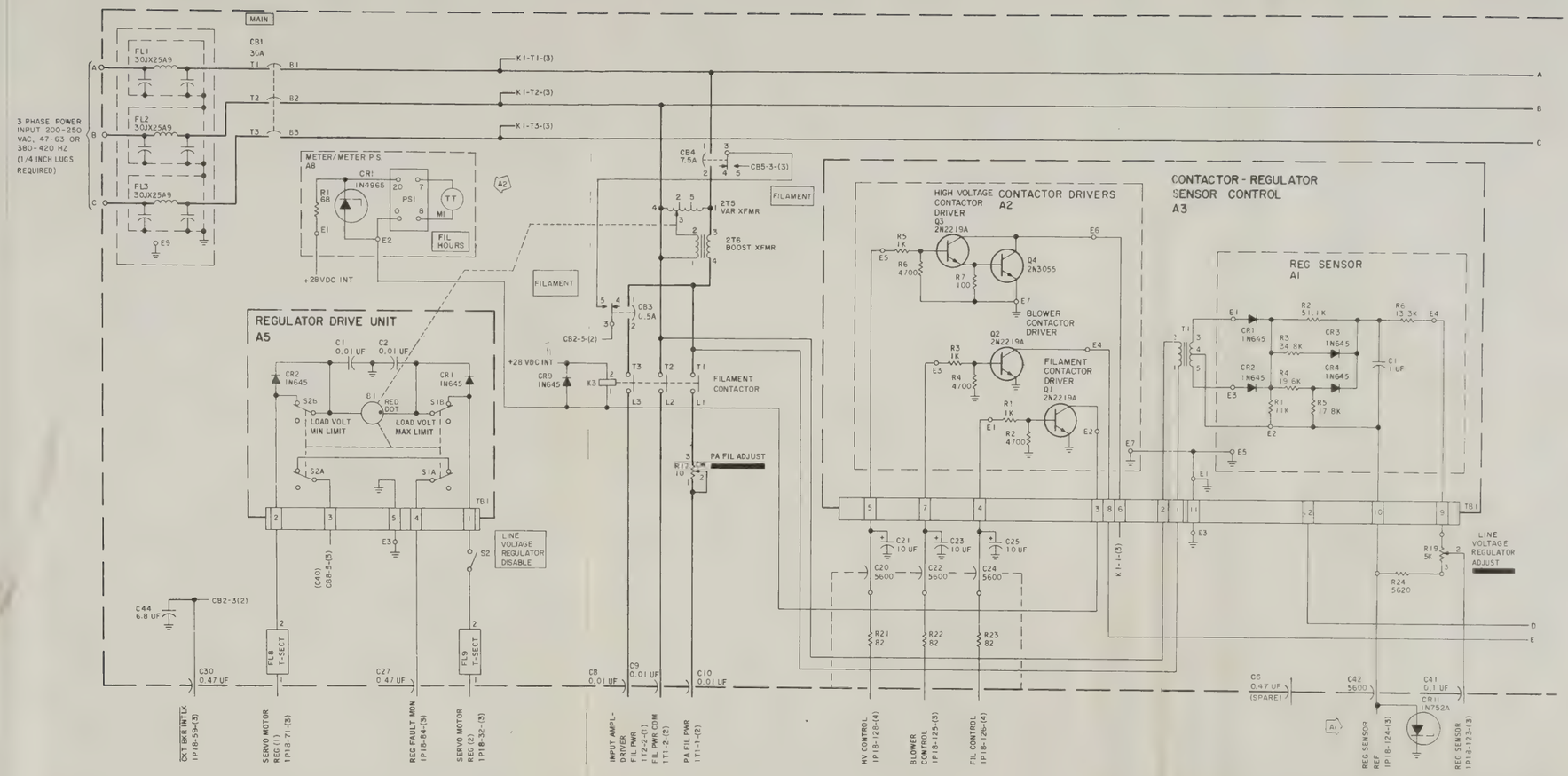


Figure 7-4. Power Supply, Unit 2, Schematic Diagram (Sheet 1 of 3)

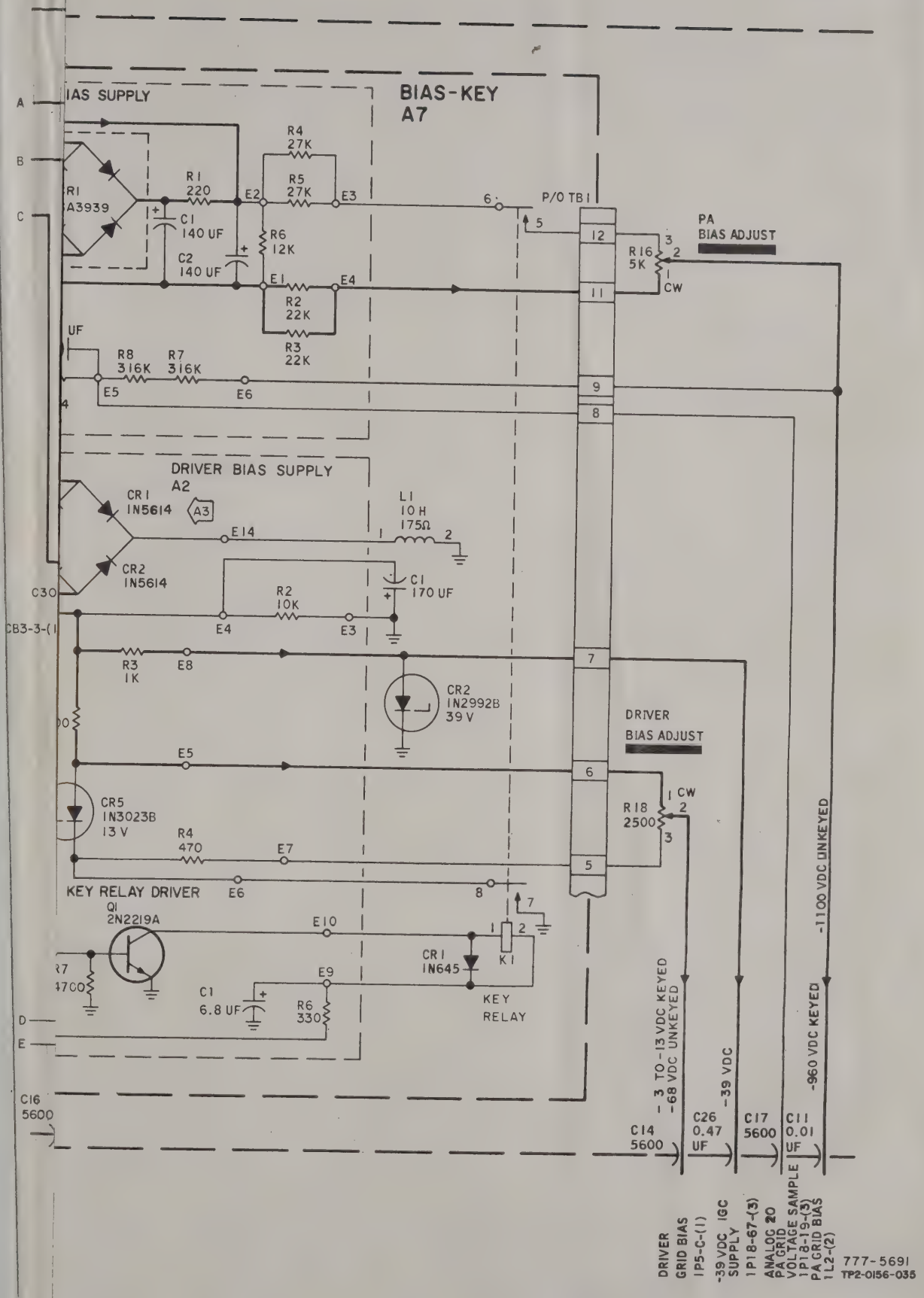


Figure 7-4. Power Supply, Unit 2, Schematic Diagram (Sheet 2 of 3)

VOLTAGE MEASUREMENTS

POINT OF TEST	E	B	C	NOTES
2A6A2Q1	-0.6	+1.4	+0.7	
2A6A2Q2	Gnd	-0.6	+0.7	
2A7A2Q1	Gnd	+0.8	+0.2	

Values shown are dc voltages with respect to chassis ground.

Test conditions: 400-Hz input power, nominal loads, plate on, high-power operation, equipment keyed.

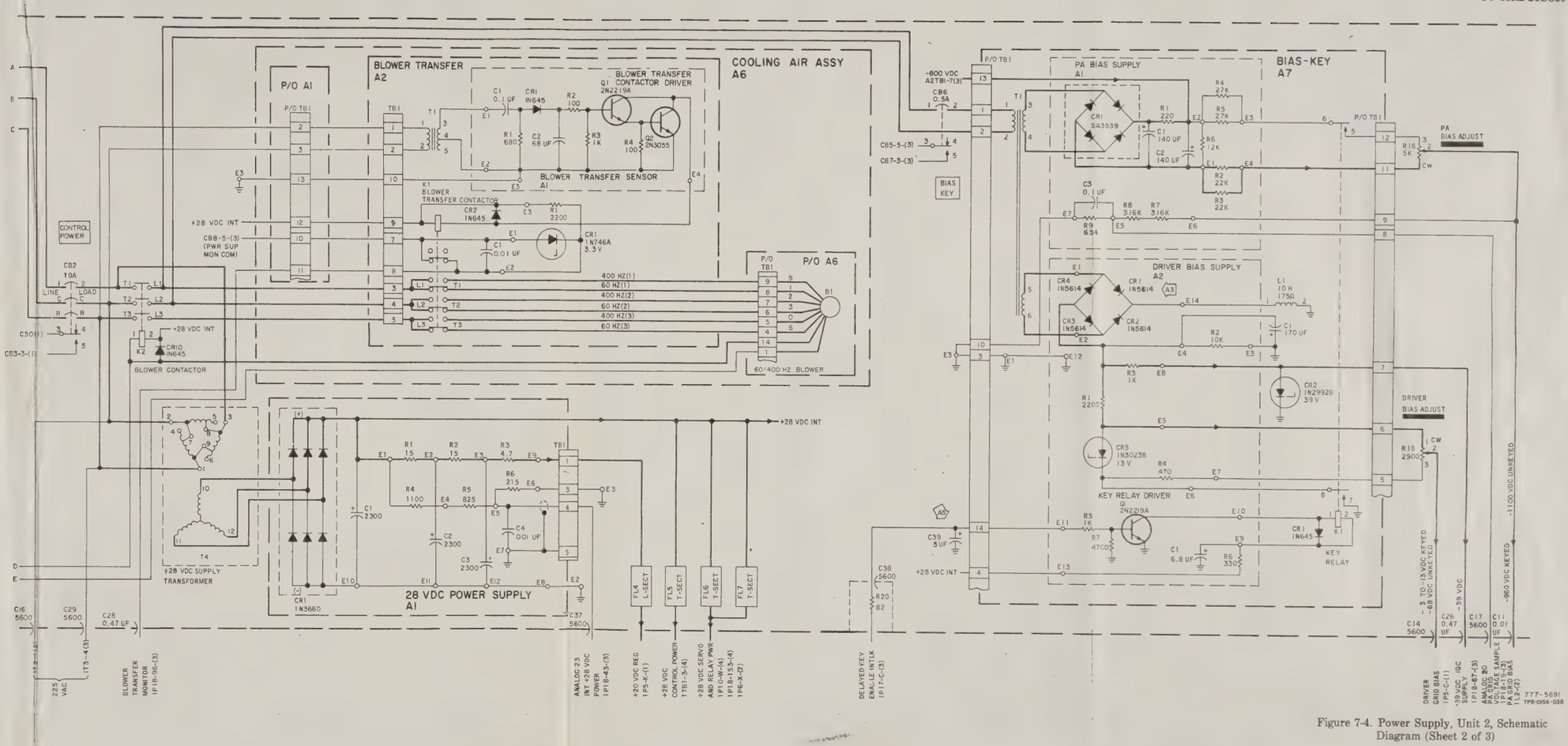


Figure 7-4. Power Supply, Unit 2, Schematic Diagram (Sheet 2 of 3)

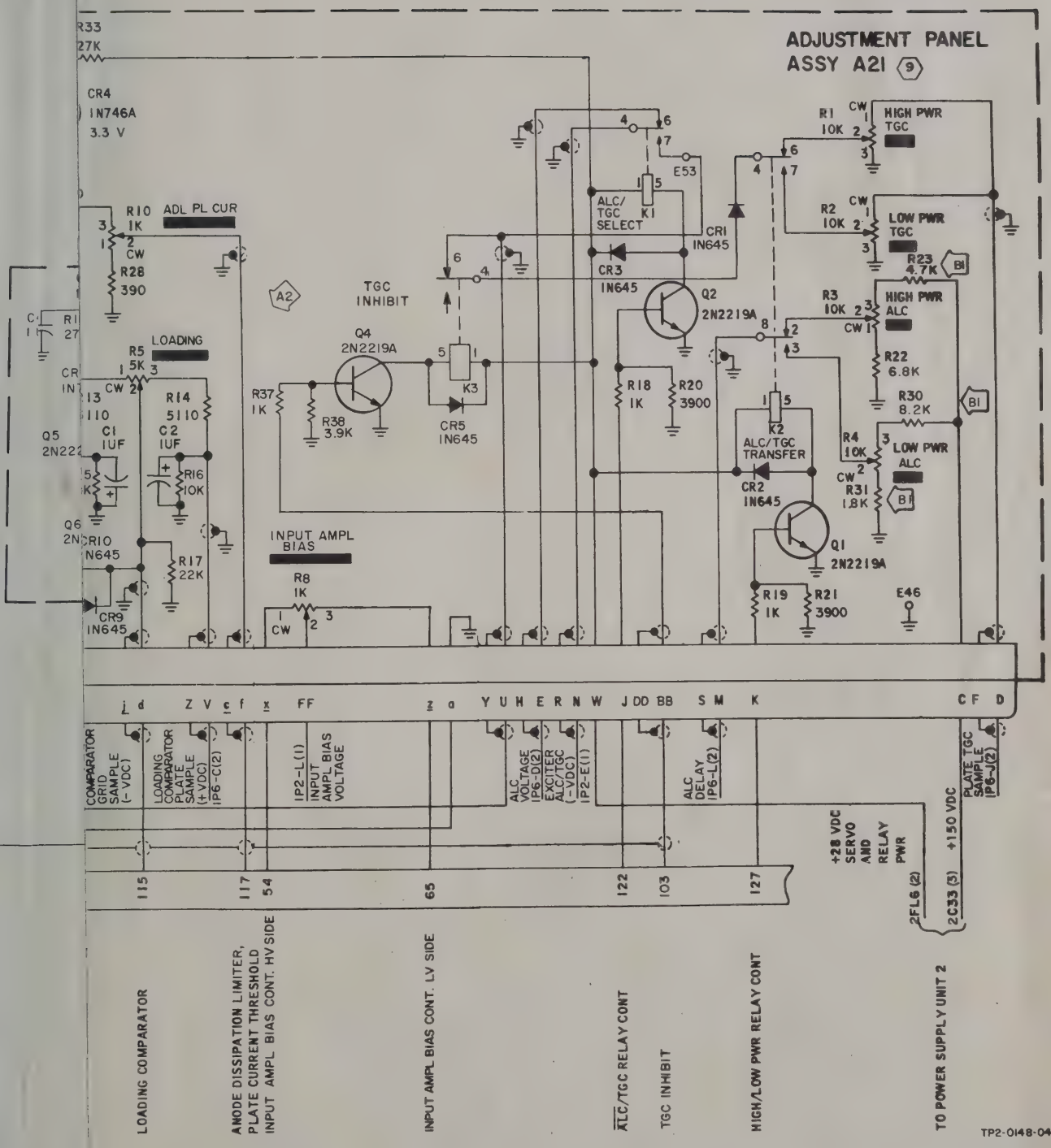


Figure 7-3. RF Amplifier, Unit 1, Schematic Diagram (Sheet 4 of 4)

VOLTAGE MEASUREMENTS

POINT OF TEST	E	B	C	NOTES
1A21Q1	Gnd	0.0	+25.7	
1A21Q2	Gnd	0.0	+1.0	
1A21Q3	Gnd	0.0	[illegible]	
1A23Q1	Gnd	+0.8	[illegible]	
1A23Q2	Gnd	-0.8	+0.1	
1A23Q3	Gnd	0.0	+1.5	
1A23Q4	+0.8	-1.5	+0.9	

Values shown are dc voltages with respect to chassis ground.

Test conditions: 400-Hz input power, nominal loads, plate on, high-power operation, equipment keyed.

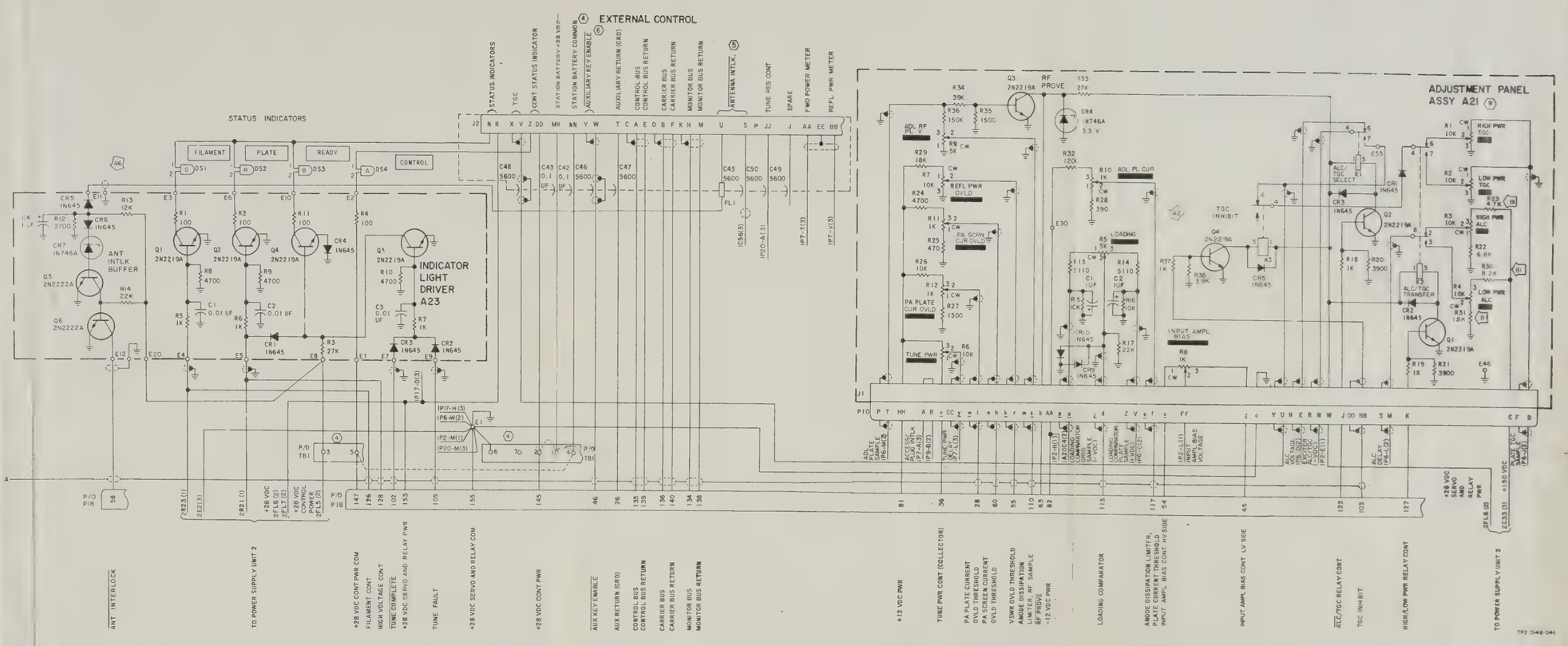


Figure 7-3. RF Amplifier, Unit 1, Schematic Diagram (Sheet 4 of 4)

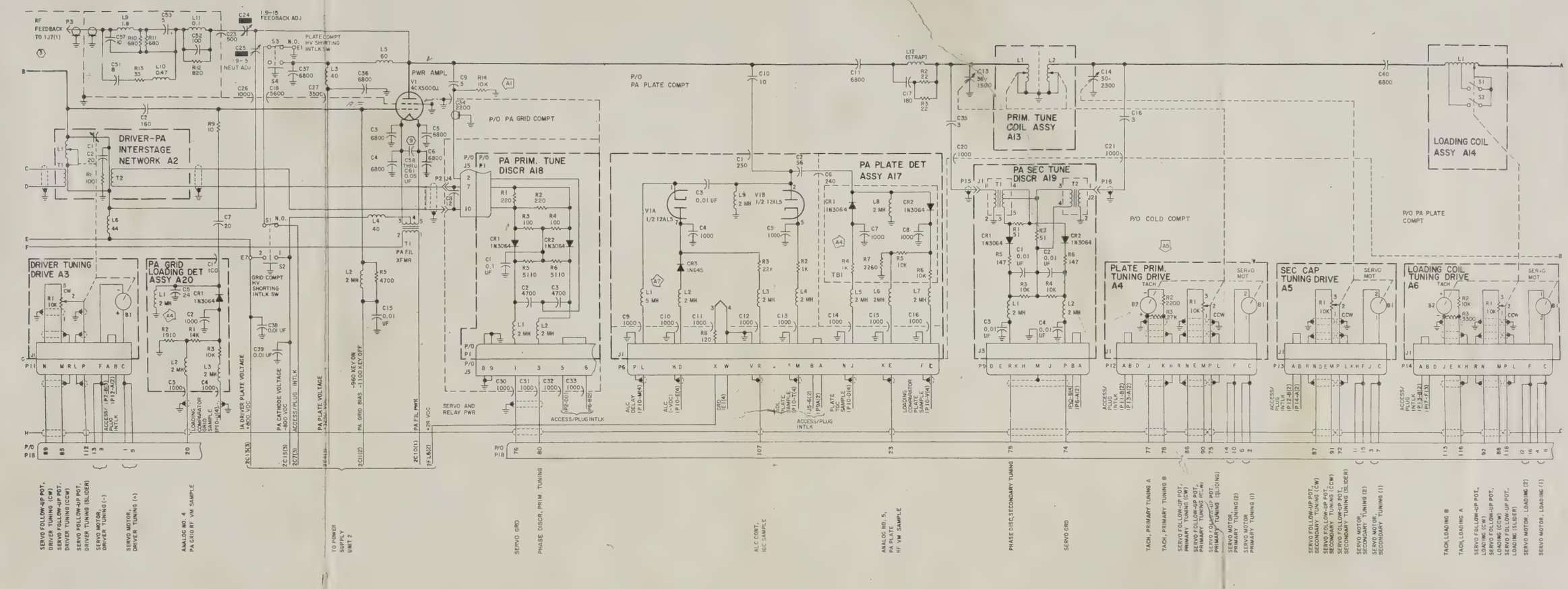
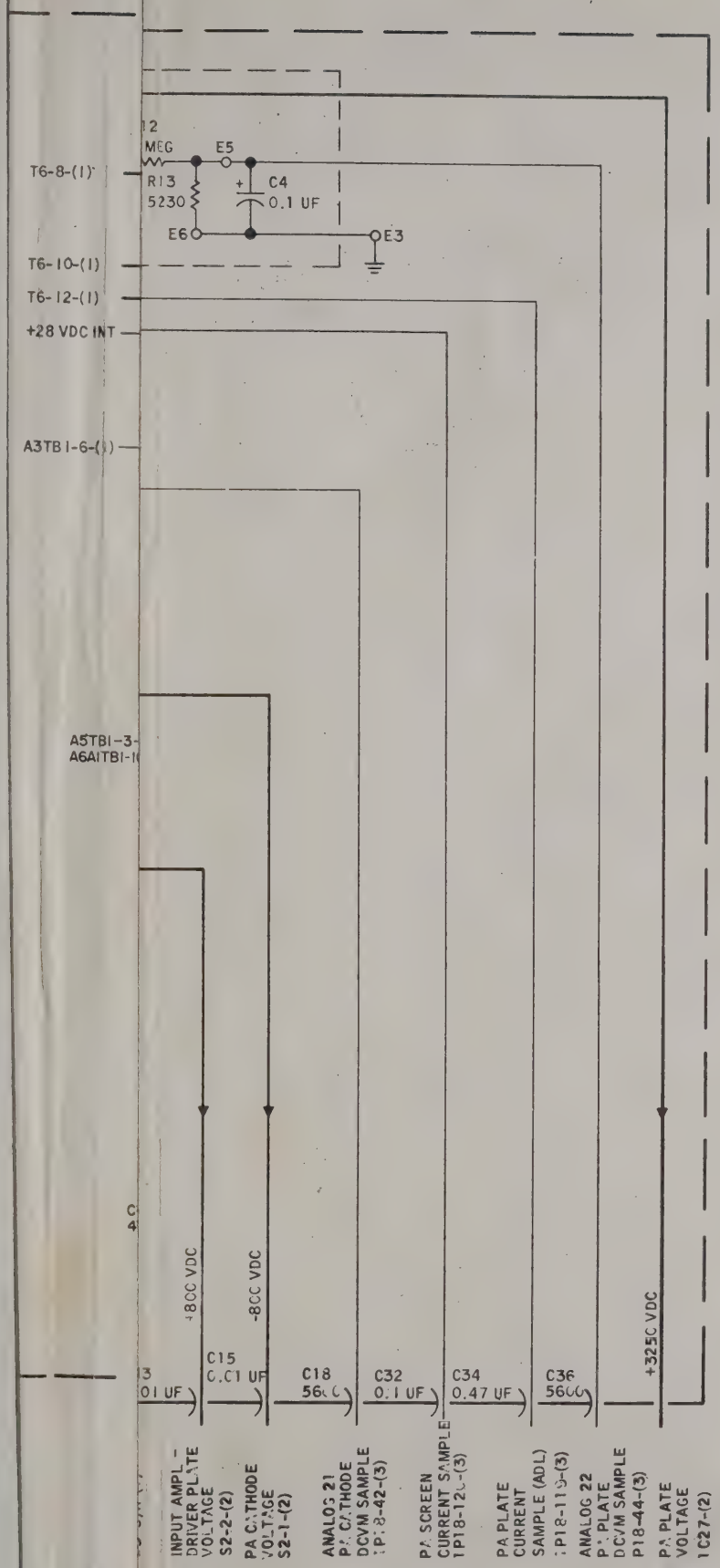


Figure 7-3. RF Amplifier, Unit 1, Schematic Diagram (Sheet 2 of 4)



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN PICOFARADS
2. DESTINATIONS OUTSIDE OF UNIT LINE ARE TO RF UNIT 1.
3. ALL CIRCUIT BREAKERS SHOWN IN OFF POSITION.
4. ALL INTERLOCKS SHOWN WITH PANELS IN PLACE.

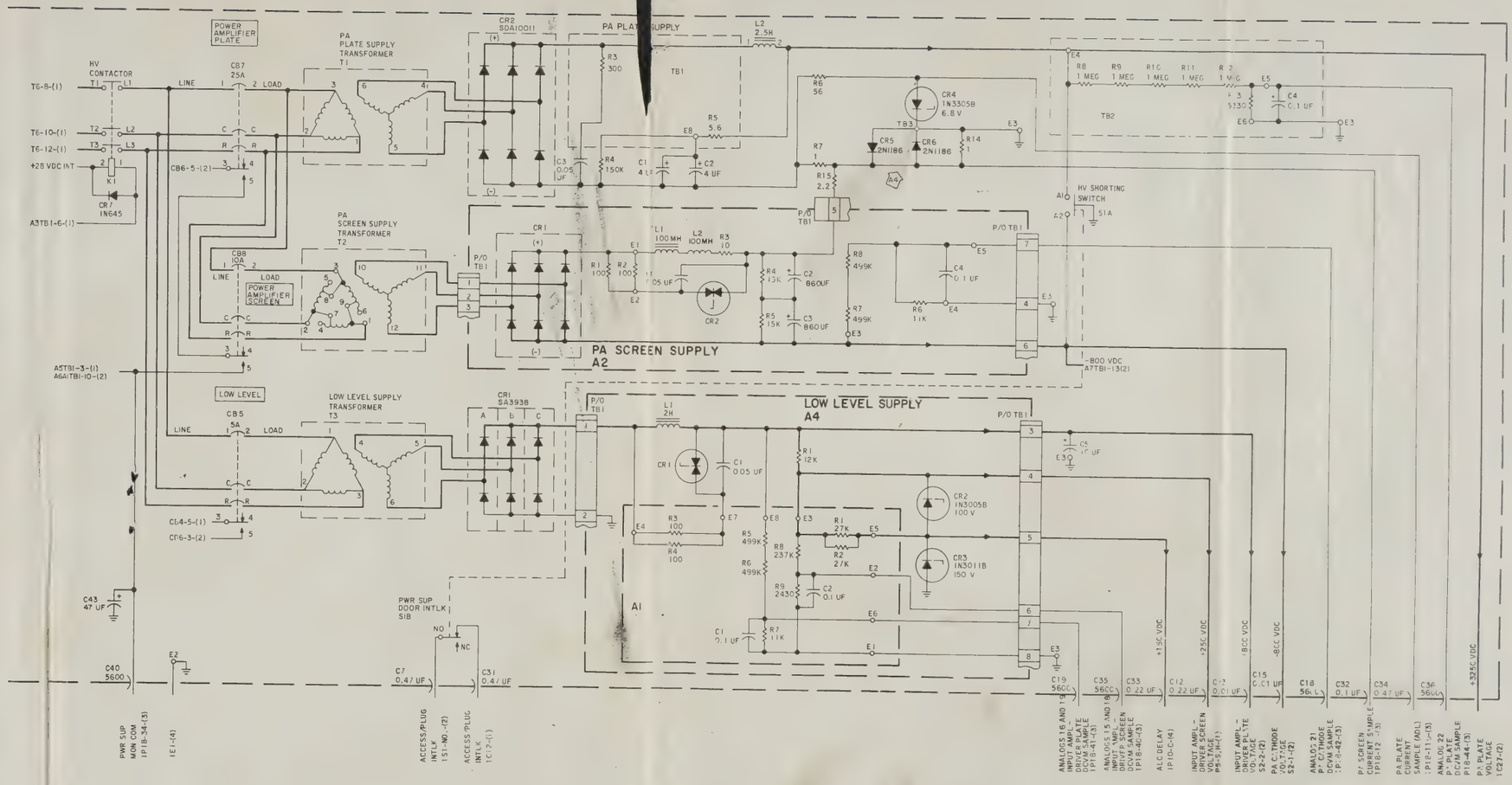
777-5691
TP2-0156-035

Figure 7-4. Power Supply, Unit 2, Schematic Diagram (Sheet 3 of 3)

VOLTAGE MEASUREMENTS

POINT OF TEST	VALUE
Input amplifier plate voltage (2C13)	+790 Vdc nominal
Pa grid voltage (2C17)	-1000 Vdc nominal
Pa cathode voltage (2C18)	-790 Vdc nominal
Driver plate voltage (2C19)	+790 Vdc nominal
Driver screen voltage (2C35)	+250 Vdc nominal
Pa plate voltage (2C36)	+3100 Vdc nominal
Control power voltage (2C37)	+28 Vdc nominal

Test point voltages may be found as analog readouts on the maintenance display unit. Refer to the maintenance manual, TO 31S1-2TSC60-12, for further information.



777-5691
TP2-0196-036

Figure 7-4. Power Supply, Unit 2, Schematic Diagram (Sheet 3 of 3)

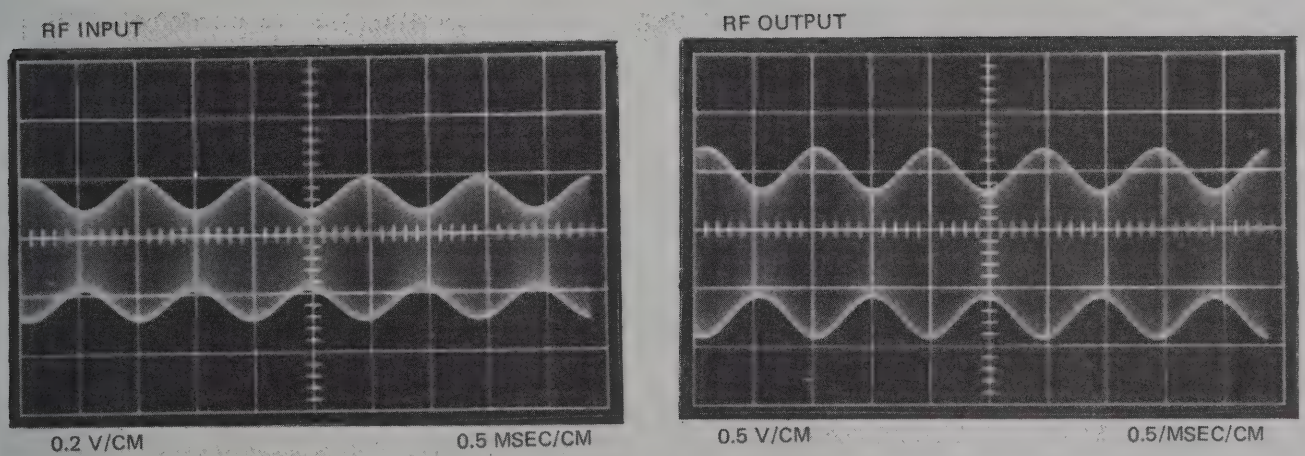


Figure 7-5. Waveforms Diagram

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